SCIENCE AND TECHNOLOGY EDUCATION AT COMMUNITY COLLEGES

HEARING

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

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SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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CONTENTS

WITNESSES

Page

April 11, 1989:

Cary A. Israel, College President, Front Range Community College, Westminster, Colorado; Dr. John Kraft, President, Community College of Alleghney County, Pittsburgh, Pa.; and William F. Willis, Chief Operating Officer, Tennessee, Valley Authority, Knoxville, Tn 11

Dr. Robert F. Watson, Director, Division of Undergraduate Science Engineering and Mathematics Education, NSF; and Dr. Daryl E. Chubin, Senior Analyst, OTA 61

Dr. John Clevenger, Department Chair, Science and Mathematics Department, Truckee Meadows Community College, Reno, Nevada; Dr. John Alexiou, Vice President of Education, Miami-Dade Community College, Miami, Florida; and Dr. Robert Menefee, Director, Science and Mathematic Programs, Montgomery County Community College, Gaithersburg, Md 99

APPENDIX

Letter to Representative Doug Walgren from Mr. Frank Mensel, Vice President for Federal Relations of the American Association of Community and Junior Colleges, April 21, 1989 134

Letter to Representative Doug Walgren from Dr. John W. Kraft, President, Community College of Allegheny County, April 24, 1989 136

Montgomery College 1988 Report to the Community, "Advancing the Public/Private Partnership" 138

"Critical Issues in Two-Year College Chemistry" 164

Newsletter of the Committee on Chemistry in the Two-Year Colleges 178

Guidlines for Chemistry and Chemical Technology Programs in Two-Year Colleges 194

SCIENCE AND TECHNOLOGY EDUCATION AT COMMUNITY COLLEGES

TUESDAY, APRIL 11, 1989

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY,
Washington, D.C.

The subcommittee met, pursuant to call, at 1:40 p.m., in Room 2325, Rayburn House Office Building, Hon. Doug Walgren, [chairman of the subcommittee] presiding.

Mr. WALGREN. Well, let me all welcome you to our hearing and apologize for a somewhat delayed start.

Today, the Subcommittee on Science, Research and Technology is holding a hearing on science and engineering education at two-year and community colleges. This important element in the education picture has been a matter of very direct interest to me and a number of other members of the subcommittee over these past several years.

Our interest grows out of the recognition that the two-year and community colleges are an extremely essential part of the educational system of the United States and play a critical role in it. The United States is confronted with two powerful forces of change. First, the demographic nature of our work force, the kind of people that we have in our population is changing. The birth rate has dropped by 30 percent and the number of new entrants into the work force in the 1990s will go down by 16 percent. Women and minorities will increase in their representation in the workplace dramatically. They will represent over 66 percent of the new workers in the next decade and, at the same time, the workplace of the future, we all know, will be increasingly complex and dependent upon technology and on technician support.

The workplace of the future will demand of workers, both blue-collar and white-collar, a higher level of familiarity and literacy with technical matters and a real degree of technical competence.

Both of these changes in our future will redefine our basic notions of education and job training. These trends lead to the question, will the United States have enough technically skilled workers to compete in the world of tomorrow and the answer can be found in the quality and availability of education. Education programs must provide a strong foundation in science and math and, in addition, students must be equipped with the ability to understand science and the ability to learn in order to be able to adapt quickly to changes in the workplace.

The nation's 1200 two-year and community colleges offer elements that can address these needs most directly. They offer low-cost programs with flexible scheduling and are, therefore, available to the widest range of the American public. The average yearly tuition at a two-year community college is something in the range of $600. A two-year community college is within easy commuting distance of almost all major urban centers.

These facts take on an added importance when it is considered that 55 percent of all first-time freshmen continuing their education after high school begin their studies at a two-year or a community college, and when you look at all undergraduate students, almost 40 percent, even more than 40 percent, attend these kinds of institutions.

Community colleges can design programs with local industry, which is specifically geared to meet immediate training needs and immediate community needs. They work directly with employers, with labor unions, with professional associations and community groups to develop and offer specialized training programs, as well as meet the skill needs of the armed forces.

Thus, the two-year and community colleges are a very critical part of our educational assets in this country.

Recently, I introduced the National Advanced Technician Training Act, H.R. 1720. This bill is similar to one that we introduced in the 100th Congress and would authorize funds for the National Science Foundation to conduct advanced technician training programs using matching non-Federal funds through community and two-year colleges.

The National Science Foundation would designate 10 centers of excellence to serve as clearinghouses for model training programs and I hope in the course of today's hearing that we will be able to get some good perspectives on what this approach might offer to strengthening community college and two-year college participation in the science—in training the science work force of the future.

We are fortunate to have a distinguished group of witnesses today and I will turn to introducing the various panels after I recognize other members for opening comments they might like to make.

So, with that, let me turn to the ranking minority member, Mr. Boehlert, from New York.

[The prepared opening statement of Mr. Walgren follows:]

OPENING STATEMENT OF THE HONORABLE DOUG WALGREN (D-PA) ON SCIENCE AND ENGINEERING EDUCATION AT TWO-YEAR AND COMMUNITY COLLEGES

April 11, 1989

GOOD AFTERNOON. TODAY THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY IS HOLDING A HEARING ON SCIENCE AND ENGINEERING EDUCATION AT TWO-YEAR AND COMMUNITY COLLEGES. THIS IMPORTANT ELEMENT IN THE EDUCATION PICTURE HAS BEEN A MATTER OF KEEN INTEREST TO ME AND THE OTHER MEMBERS OF THIS SUBCOMMITTEE OVER THE PAST SEVERAL YEARS. THIS INTEREST GROWS OUT OF THE RECOGNITION THAT TWO-YEAR AND COMMUNITY COLLEGES ARE THE BACKBONE OF POST SECONDARY EDUCATION IN THE UNITED STATES.

THE UNITED STATES IS CONFRONTED WITH TWO POWERFUL FORCES OF CHANGE. FIRST, THE DEMOGRAPHIC NATURE OF OUR WORKFORCE IS CHANGING. THE BIRTHRATE HAS DROPPED BY 30 PERCENT AND THE NUMBER OF NEW ENTRANTS INTO THE WORKFORCE IN THE 1990's WILL GO DOWN BY 16 PERCENT. WOMEN AND MINORITIES (BLACKS, HISPANICS, AND ASIANS) WILL REPRESENT OVER 66 PERCENT OF THE NEW WORKERS IN THE NEXT DECADE. SECOND, THE WORKPLACE OF THE FUTURE WILL BE INCREASINGLY COMPLEX, DEPENDENT ON TECHNOLOGY, AND SUBJECT TO RAPID CHANGE. THE WORKPLACE OF THE FUTURE WILL DEMAND OF WORKERS, BOTH BLUE COLLAR AND

WHITE COLLAR, A HIGHER LEVEL OF LITERACY AND TECHNICAL COMPETENCE. BOTH OF THESE MAJOR CHANGES FORCE US TO REDEFINE OUR BASIC NOTIONS OF EDUCATION AND JOB TRAINING.

THESE TRENDS LEAD TO THE QUESTION: WILL THE U.S. HAVE ENOUGH TECHNICALLY SKILLED WORKERS TO COMPETE IN THE WORLD MARKETPLACE? THE ANSWER TO CAN BE FOUND IN THE QUALITY AND AVAILABILITY OF EDUCATION. SPECIFICALLY, EDUCATION PROGRAMS MUST PROVIDE A STRONG FOUNDATION IN SCIENCE AND MATHEMATICS. IN ADDITION, STUDENTS MUST BE EQUIPED WITH THE NECESSARY LITERACY AND LEARNING SKILLS IN ORDER TO BE ABLE TO ADAPT QUICKLY TO CHANGES IN WORKPLACE TECHNOLOGY.

THE NATION'S 1,222 TWO-YEAR AND COMMUNITY COLLEGES OFFER ELEMENTS THAT CAN ADDRESS THESE NEEDS. THEY OFFER LOW-COST PROGRAMS WITH FLEXIBLE SCHEDULING. THE AVERAGE YEARLY TUITION AT A TWO-YEAR OR COMMUNITY COLLEGE IS $660 AND A TWO-YEAR OR COMMUNITY COLLEGE IS WITHIN EASY COMMUTING DISTANCE OF 90 PERCENT OF ALL AMERICANS. THESE FACTS TAKE ON ADDED IMPORTANCE WHEN IT IS CONSIDERED THAT 55 PERCENT OF ALL FIRST-TIME FRESHMEN BEGIN THEIR STUDIES AT A TWO-YEAR OR COMMUNITY COLLEGE AND 41 PERCENT OF ALL UNDERGRADUATE STUDENTS ATTEND THESE INSTITUTIONS. COMMUNITY COLLEGES CAN DESIGN PROGRAMS WITH LOCAL INDUSTRY SPECIFICALLY GEARED TO MEET IMMEDIATE AND LONG-TERM TRAINING NEEDS.

THEY WORK DIRECTLY WITH EMPLOYERS, LABOR UNIONS, PROFESSIONAL ASSOCIATIONS, AND COMMUNITY GROUPS TO DEVELOP AND OFFER SPECIALIZED TRAINING PROGRAMS, AS WELL AS MEET THE CRITICAL SKILL NEEDS OF THE ARMED FORCES. THUS, TWO-YEAR AND COMMUNITY COLLEGES ARE A VALUABLE NATIONAL ASSET IN OUR STRUGGLE TO MAINTAIN OUR LEADERSHIP IN THE WORLD ECONOMY.

RECENTLY, I REINTRODUCED THE NATIONAL ADVANCED TECHNICIAN TRAINING ACT, H.R. 1720. THIS BILL IS VIRTUALLY IDENTICAL TO H.R. 2134, INTRODUCED IN THE 100TH CONGRESS. H.R. 1720 AUTHORIZES FUNDS FOR THE NATIONAL SCIENCE FOUNDATION (NSF) TO CONDUCT ADVANCED TECHNICIAN TRAINING PROGRAMS, USING MATCHING NON-FEDERAL FUNDS. NSF WOULD DESIGNATE TEN CENTERS OF EXCELLENCE TO SERVE AS CLEARINGHOUSES FOR MODEL TRAINING PROGRAMS. I HAVE ASKED EACH OF THE WITNESSES TO COMMENT ON H.R. 1720.

TODAY WE ARE FORTUNATE TO HAVE AN ARRAY OF DISTINGUISHED AND KNOWLEDGEABLE WITNESSES. THE FIRST PANEL CONSISTS OF MR. CARY ISRAEL, PRESIDENT OF FRONT RANGE COMMUNITY COLLEGE. MR. ISRAEL AND FRONT RANGE COMMUNITY COLLEGE, HAVE BEEN GIVEN THE "KEEP AMERICA WORKING AWARD" AS RECOGNITION FOR THEIR INNOVATIVE TRAINING AND RETRAINING PROGRAMS FOR WORKERS IN COLORADO. DR. JOHN KRAFT IS THE

PRESIDENT OF THE COMMUNITY COLLEGE OF ALLEGHENY COUNTY IN PITTSBURGH, PENNSYLVANIA, AND MR. WILLIAM WILLIS IS THE CHIEF OPERATING OFFICER OF THE TENNESSEE VALLEY AUTHORITY. BOTH DR. KRAFT AND MR. WILLIS HAVE EARNED A NATIONAL REPUTATION FOR THE IMAGINATIVE PROGRAMS THAT LINK COMMUNITY COLLEGES WITH LOCAL INDUSTRIES.

THE SECOND PANEL INCLUDES DR. ROBERT WATSON, DIRECTOR OF THE DIVISION OF UNDERGRADUATE SCIENCE, ENGINEERING, AND MATHEMATICS EDUCATION OF THE NATIONAL SCIENCE FOUNDATION AND DR. DARYL CHUBIN, SENIOR ANALYST AT THE OFFICE OF TECHNOLOGY ASSESSMENT. DR. WATSON WILL DESCRIBE THE PROGRAMS AT NSF THAT RELATE TO TWO-YEAR AND COMMUNITY COLLEGES, AS WELL AS THE RECENT NSF REPORT ON THE STATUS OF EDUCATION AT TWO-YEAR AND COMMUNITY COLLEGES. DR. CHUBIN WILL DISCUSS DEMOGRAPHIC CHANGES, AS WELL AS THE ROLE TWO-YEAR AND COMMUNITY COLLEGES PLAY IN PREPARING STUDENTS FOR STUDY AT FOUR-YEAR INSTITUTIONS.

THE THIRD PANEL CONSISTS OF DR. JOHN CLEVENGER OF TRUCKEE MEADOWS COMMUNITY COLLEGE IN RENO, NEVADA; DR. JOHN ALEXIOU, VICE PRESIDENT OF EDUCATION AT MIAMI-DADE COMMUNITY COLLEGE; AND DR. ROBERT MENEFEE OF MONTGOMERY COUNTY COLLEGE IN GAITHERSBURG, MARYLAND. THESE WITNESSES WILL DESCRIBE INNOVATIVE PROGRAMS IN SCIENCE, MATHEMATICS,

AND TECHNICAL INSTRUCTION. DR. ALEXIOU WILL GIVE US A PERSPECTIVE ON THE NEEDS OF WOMEN AND MINORITY STUDENTS.

THE SUBCOMMITTEE INVITED THE DEPARTMENT OF EDUCATION AND THE DEPARTMENT OF LABOR TO SEND A REPRESENTATIVE TO TESTIFY AT TODAY'S HEARING. THE INVITATION WAS MADE FOR THE PURPOSE OF LEARNING WHAT, IF ANYTHING, THESE TWO DEPARTMENTS ARE DOING IN RELATION TO TWO-YEAR AND COMMUNITY COLLEGES. UNFORTUNATELY, THEY BOTH DECLINED TO APPEAR.

WE WELCOME ALL THE WITNESSES AND THANK THEM FOR THEIR TIME AND EFFORT IN MAKING THIS HEARING A SUCCESS.

LET'S START WITH THE FIRST PANEL.

Mr. BOEHLERT. Thank you, Mr. Chairman.

It is a pleasure to be here this afternoon to draw attention to—and I think more importantly, to find some solutions for the problems of two-year and community colleges. Community colleges are really the Cinderellas of our educational system. Treated like inadequate step-sisters by the rest of the higher education family, two-year schools have been too often banished to the shadows, where policymakers are unlikely to find them.

But you know how the Cinderella story finally turns out, and I think that with the proper assistance, community colleges could easily turn out to be the beautiful princesses of our educational system, the ones who attract tens of thousands of Americans to careers they otherwise would have abandoned.

Now, I have some questions about whether H.R. 1720 is the magic wand that will work this transformation and whether Eric Block is the only prince who can discover the hidden charms, but I have no question that the Federal Government needs to do more for community colleges and that the National Science Foundation must ensure that community colleges take full advantage of its programs. That is why I authored the language two years ago requiring the National Science Foundation report on the needs of community colleges and how NSF could help fill them.

I look forward to learning from our witnesses today what programs they are now running and precisely what assistance their schools most need. Inspired by their information, Mr. Chairman, I think we can work to see that American students live happily ever after.

Thank you.

Mr. WALGREN. Thank you very much, Mr. Boehlert. That's a good analogy.

Other opening comments?

Mr. Skaggs?

Mr. SKAGGS. Thank you, Mr. Chairman.

It is always difficult to follow one of Mr. Boehlert's pieces of poetry and—

Mr. WALGREN. It's all right. The secret is it's ghost-written and—

Mr. SKAGGS. But he delivers it very well.

Mr. WALGREN. Sorry about that.

Mr. BOEHLERT. Truth in government.

Mr. SKAGGS. In any case, I appreciate the chairman's leadership in convening these hearings.

I think those of us that sat in for a time this morning on the full committee's hearings dealing with the creation of new wealth and the importance of productivity gains that we're going to have to make happen in the service sector of the economy in particular would be well-advised to pay attention to the subject matter this afternoon and the very important role that education programs that deal with adult education and retraining and initial professional training at something beneath the four-year college effort, the role that those programs are going to have to play in making the kind of productivity gains that are essential if we're going to be able to hold this economy on course for the next 20 or 30 years, and certainly the community colleges are going to be a very central resource in our efforts to make that happen.

If I may, Mr. Chairman, I'd like to take this opportunity also to extend greetings to one of the members of our first panel of witnesses, Mr. Cary Israel, who is president of Front Range Community College in the district that I am privileged to represent. It's Mister rather than Doctor Israel. He's the proud possessor of a law degree and I think his role in education is a worthy indicator that all of us that carry JD or LLBs after our names really can be productive contributors to social well-being and so it's a treat to have Mr. Israel with us this afternoon.

His institution, Front Range Community College, has also just been a terrific example of what can be accomplished with a devoted effort at the community college level in programs that are geared to training and retraining of personnel in cooperative private industry in the neighborhood; in particular, Front Range Community College was one of three institutions that received one of the partnership awards from the American Association of Community and Junior Colleges for its program with IBM, and I'm sure we will hear some more about that during Mr. Israel's testimony. He's also been very, very helpful with me, Mr. Chairman, and we can recall the hearings that you held with me in Denver a couple of years ago on technology transfer.

Front Range Community College, under Mr. Israel's leadership, was one of two institutions that got together with me to plan and carry out a technology transfer conference workshop last July. We are in the midst of planning our second annual now and so he's really demonstrated his commitment to making some of these things that we talk about a lot happen, and I look forward to his testimony.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Skaggs.

Other opening comments?

Mr. Slaughter.

Mr. SLAUGHTER. Mr. Chairman, first of all, I'd like to commend you for holding these hearings on community colleges. I think it's certainly very informative that at this particular time, as we are looking at the picture of higher education and high technology, that the community colleges be considered. I know in my State, for many years, my State of Virginia, for many years, the community colleges have played a very important part in our educational system and I know that they do so across the country, and I think it's well that we be brought up to date on the developments in that area.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Slaughter.

Mr. Price.

Mr. PRICE. Thank you, Mr. Chairman.

I apologize for my sporadic attendance today. It has to do with the mark-up of the savings and loan bill that's going on two floors beneath us. It certainly doesn't indicate any lack of interest on my part.

In fact, I want to commend you very strongly for convening these hearings on science and engineering education at two-year and community colleges.

The subcommittee recognizes that the strength and prosperity of this country will depend on our ability to outfit the American worker with the skills and education necessary to—necessary in the factory or office of tomorrow, a workplace we know is going to be increasingly complex and dependent on technology and subject to rapid change.

All too often, we are failing—falling short of this challenge. Overall technical skills of U.S. workers have actually declined since the 1970s, and in many areas, school drop-out rates are increasing.

Our community colleges, we all know, are on the front lines of our national effort to upgrade our workers' skills and to provide training that meets workplace needs. Yet, all acknowledge that we're reaching only a small fraction of those we need to reach.

Today's hearing follows up on a field hearing that this subcommittee held on November 9, 1987, in Research Triangle Park, North Carolina, concerning workplace literacy. The testimony we heard then was disturbing. Educators talked about young adults with minimal ability to read, write, analyze, operate a computer or read a technical manual.

Business leaders described their problems in finding workers with the skills necessary for increasingly demanding jobs.

Last week, I and others in the congressional Sunbelt Caucus convened a work force literacy summit with congressional, education, labor and literacy leaders from across the South. The message from that summit, as from our hearings 18 months ago, was very clear.

We can no longer put off improving our adult literacy, vocational education and basic science and math education programs. We must design education and training initiatives that facilitate our workers' ability to adapt to changes in the workplace. It's time to devise specific remedies.

I look forward to these hearings today as a further contribution to this effort.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Price, very much.

Any other opening statements the members would like to make at this point?

If not, we'll turn to our first panel. Mr. Cary Israel, President of the Front Range Community College, has been introduced by Mr. Skaggs. We welcome you to our process, Mr. Israel.

The—Mr. Israel and the Front Range Community College have been given the Keep America Working Award as recognition of their training programs in that part of the country and we are pleased to have you with us today.

Also, Dr. John Kraft will join the first panel. John—Dr. Kraft is the President of the Community College of Allegheny County, which is in my home of Pittsburgh, Pennsylvania, and we are very pleased you could be here with us, Dr. Kraft.

Mr. William Willis, the Chief Operating Officer of the Tennessee Valley Authority.

All have earned national reputations for the kinds of programs that link community colleges with local industries. So we welcome you all, gentlemen, to our panel, and please come forward and let

me invite you to—to give your testimony and emphasize points you'd like to make in whatever way you feel most effective.

The written statements or submissions that you'd like to make to us will be made part of the record that it will then be worked with by those who work with these proceedings without further, so you can feel free to underscore and diverge from any written statement you would like to emphasize points in the oral part of your testimony.

Mr. BOEHLERT. Mr. Chairman?

Mr. WALGREN. Mr. Boehlert.

Mr. BOEHLERT. After hearing Mr. Skaggs' eloquent introduction of Mr. Israel, I was tempted to say how refreshing it is to find an attorney in this town who is making an honest living, but I will resist that temptation.

Welcome.

Mr. WALGREN. But I do want to say at the outset, I'd like witnesses, if you would try to make your points within perhaps seven to eight minutes or thereabouts--is that the time we settled on—so that we can get through our process in a timely fashion. It would be—it would be appreciated.

So with that, let's start with Mr. Israel and we'll go through the panel in the order in which I introduced you to the record.

Mr. Israel.

STATEMENTS OF CARY A. ISRAEL, COLLEGE PRESIDENT, FRONT RANGE COMMUNITY COLLEGE, WESTMINSTER, COLORADO; JOHN W. KRAFT, PRESIDENT, COMMUNITY COLLEGE OF ALLEGHENY COUNTY, PITTSBURGH, PENNSYLVANIA; AND WILLIAM F. WILLIS, CHIEF OPERATING OFFICER, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENNESSEE

Mr. ISRAEL. Thank you, Mr. Chairman, and thank you, committee members and Mr. Skaggs, for a nice introduction.

I am Cary Israel, President, Front Range Community College. I have been in Westminster, Colorado, for the last two and a half years as President. Westminster is nine miles north of Denver. We have a service area that goes all the way up to the Wyoming border at the present time.

A highly skilled and motivated labor force is really an important strategy used by both domestic and foreign manufacturers to obtain and maintain high levels of productivity and product qualities.

In our new information, technological age, employees have to have life-long learning. They are continually are going to have to upgrade themselves in new technical systems, new operating philosophies and procedures.

We're already experiencing in our country a shortage of machinists. Machinists carry an average age of 58 and we are only training one-quarter of all the machinists needed in this country each year. There's a trend in machining toward sim-cells, or computer-integrated manufacturing cell, yet in the State of Colorado, there's not one that exists for training purposes.

Does current legislation or policy development do enough to encourage a well-trained and educated work force? I think not.

What's happening, paradoxically, is that Federal and State legislation provides money for short-term training, yet new technological skills demand long-term training, at least two years.

Carl Perkins legislation is critical in order to keep our equipment in order; however, new and emerging occupations are not vocational in nature. I will talk about that.

We created the first hazardous waste associate of science degree in the nation, to train people in hazardous waste technology. We chose to have an AS degree or an associate of science degree because many Federal agencies in management level demand a master's degree.

If a person would start at an AAS degree or a vocational degree, it would cost them another year to attend the university in order to upgrade themselves. By doing so, creating it as an associate of science degree, we no longer can tap into Carl Perkins funds because we are not vocational.

NSF talks about course and curriculum improvement as being espoused as a prospective funding area. I would entertain that curriculum development is being handled very well by the community colleges and by business and industry and what we need is not curriculum development; we need equipment, and we need laboratories.

Again, Carl Perkins allows to acquire equipment if we were a vocational degree, which we're not, but it does not allow for the renovation, the mass renovations of labs that are necessary.

Our hazardous waste training program was developed with Hewlett Packard, Browning Ferris Industry, IBM, Coors, Congressman David Skaggs' office, Rockwell International and many others. We needed seed capital. We obtained $75,000, but we needed $300,000 to create a state-of-the-art lab for training.

Again, we had difficulty. We made application for NSF funding, to no avail, maybe because it was a unique program in the nation, maybe dollars were going to research institutions, but of the 200 students that started this program this last fall, 30 percent already have a bachelor's or higher degree. We have four Ph.D.s in our program. We are retooling oil and gas geologists, who are unemployed, through this hazardous waste program.

In this program, it is riddled with science courses. So as they walk into a state-of-the-art hazardous waste facility, they're being trained by antiquated equipment, resources in our math, chemistry and biology departments because, again, we cannot tap into funding.

This partnership has been very beneficial. We hire a lot of Ph.D.s from Rockwell International, Rocky Flats, to be adjunct professors. By the way, they have more Ph.D.s at that facility than we do at our own institution. So it's not the curriculum and it's not the faculty; it's, again, the lack of tapping into resources to have a current technological lab and current equipment to train the force.

We entered into one of the first programs the United States with Ford Motor Company. We train in a seven-State region technicians. We don't call them mechanics any longer. They're not grease monkeys. They need to be sophisticated in computers, in physics and electronics. Ford donates $350,000 worth of new equipment each year, $150,000 each year in software development, so we have a

wonderful Ford ASSET training lab. People come from all seven States into our facility to be trained.

Yet, when we send them to our physics lab, or we send them to our chemistry lab, which is mandated as part of the curriculum, again they're working with antiquated equipment because we can't keep the funding up.

The partnership with Ford is to train automotive technicians. It is not to train biology or physics students. I don't know how a college can forge an alliance with a physics company. I've tried.

We recently developed the first literacy lab in the United States with Unisys Corporation. Unisys Corporation has been doing wonderful things in literacy and technology in computers, but it has been in Canada, and it hasn't been in the United States. So we entered—we entered into an agreement. We got funding from the State of Colorado and we have now the first literacy lab in the United States with Unisys Corporation in a higher education facility.

Would NSF fund a literacy lab? It's not a science program. It's not a technology program, but it is critical to the individuals that are coming from other countries who are ESL students. It's critical to the hundreds of thousands of illiterates in our State and it's critical to the 23 million functionally illiterates in this country.

The lab costs well over $100,000. We pulled enough resources together for a 20-terminal lab. Obviously, we're not going to do too much of a dent in that.

As Congressman Skaggs alluded to, we were fortunate to receive the first partnership award this year with AACJC on our IBM project. We trained over 2000 employees in the Boulder plant, also in Vermont, Bethesda, Maryland, and Austin, Texas.

What IBM is doing as a corporation is remissioning or changing their work force from a manufacturing operation to a software development and systems support. What we developed was career transitions and retraining preparedness. In essence, we got the work force, who had been manufacturing for a decade, ready to be trained.

Again, these type of unique programs that are being developed are not ones that can be funded because they don't fall in the guidelines, or what someone was talking about.

I, myself, do not think that we have vocational programming taking place at Front Range Community College. What we have taking place is technological programs that are math- and science-based. Again, if we change the name from vocational to technological, we might have some problems with funding resources.

Lastly, I'd like to conclude in that we keep talking about blue-collar and white-collar. I propose that in this country, we should start talking about bright-collar and new-collar, and bright-collar employees are individuals who are going to use intellectual initiative to solve problems with the current technology.

And so I see that manufacturing might be going by the wayside as far as training if we don't have enough funding for equipment—if we don't look at things differently than what we've been looking at in a policy perspective.

I thank you for the opportunity of speaking and we'll entertain any questions you have later.

[The prepared statement of Mr. Israel follows:]

Joint Commission On Federal Relations

AACJC

Testimony

on

H.R. 1170

Science and Technical Education in Community Colleges

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by

Cary Israel, President
Front Range Community College
Westminster, Colorado

before the

Subcommittee on Science, Research and Technology
Committee on Science, Space, and Technology
U.S. House of Representatives

April 11, 1989

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Mr. Chairman, the national interest is well served by this timely hearing, and we thank you wholehartedly for convening it. My name is Cary Israel. I am President of Front Range Community College of Westminster, Colorado, and I was asked to testify about our concerns for technical education, growing out of specific programs in our college that address the changing skill needs of the dynamic global employment market.

Community colleges across the nation are playing key roles in attracting new businesses, developing and maintaining small business support systems, training new workers, helping in retraining and upgrading existing employees, and working in the international markets. Why is this approach needed? During recent years, external economic forces have brought sweeping changes to our society. Technology and service delivery seems to be driving all the world economies, and literally offering unparalled opportunities for the continuous creation of new wealth and an upscaled quality of life. However, it is critical that employers train and use their human resources fully and effectively to take advantage of the benefits that technology has to offer.

A highly skilled and motivated labor force is an important strategy used by domestic and foreign manufacturers to obtain and maintain high levels of productivity and product quality. Employees must be continually educated on new technical systems and new operating philosophies and procedures. Education standards must be raised and accountability measures must be adopted. Students/trainees must go to school longer, conquer courses that improve our ability to analyze, synthesize, evaluate, and create, and understand that life-long education is now a necessity.

Do current legislation or policy development do enough to encourage a well trained and educated workforce? The nation's downward slide in global competition suggests the answer.

* Paradoxically, federal and state legislation seems to provide monies and resources for short-term training, while the new emerging technological occupations require a minimum of two years of specialized education and training.
* Carl Perkins funding is critical in order to keep our occupational programs current with new equipment. But new and emerging occupations require an Associate of Science degree and they are not eligible for vocational dollars even though their equipment needs are just as dramatic and universal. In fact, there is such a blending of curriculum taking place that one may not be able to differentiate between a vocational program and a science and math based technological program in the future.
* Course and curricula improvement is being espoused as an area for prospective funding. However, business and industry are providing great assistance and expertise in curriculum development. We desperately need new equipment and laboratories to enhance the educational learning process. We may have crumbling infrastructure and outdated equipment but great curriculum.

Let me provide some real examples at Front Range Community College. We recently created the first Associate of Science Degree in Hazardous Waste Technology in the nation. We all realize that there is a pressing need for well trained technicians in this emerging occupation. With representatives

from the Colorado Department of Health, Hewlett Packard, Browning Ferris Industry, IBM, Coors, Jacob Engineering, Congressman David Skaggs' Office, the FRCC science faculty, Rockwell International, and many others, we developed a model hazardous waste curriculum. What we were lacking was seed capital to acquire the basic scientific equipment of analyzing hazardous waste, storing hazardous waste, sampling hazardous waste, and a lab to instruct the new student in this important field.

While we received generous donations to the tune of $75,000 from the private sector, it was well short of the $300,000 needed for an appropriate educational lab. We submitted a grant proposal to NSF for equipment acquisition but failed to obtain a grant. We may have not written an appropriate proposal or universities may have been given preference on needed equipment for important research. The bottom line is that 200 students (by the way, 32 percent of all enrolled students have a Bachelors of Science degree or higher) who are now in the program are being short-changed in obtaining practical scientific knowledge and competitive career skills.

To provide this knowledge, we must teach them integrated basic scientific theories (chemistry, physics, biology, and math), scientific methods of application using the most recent technologies and instrumentation (gas and liquid chromatography, infrared spectrophotometry, polarized light and electron microscopy). These students need college transfer courses to continue their studies at the universities but they also need the latest technological and computer skills, which we can teach them at the community college if we have funds to buy the equipment.

When we developed this new program there were no funds available for this type of scientific training for a college transfer program so we also incorporated an occupational certificate to make the program eligible for Carl Perkins money, in order to obtain some necessary technological equipment.

During the training of this workforce, we developed a partnership with Rockwell International, the operators of Rocky Flats plutonium production plant for nuclear energy development. The labor force in this plant handles many radioactive and hazardous materials. Also the plant produces hazardous wastes with low-level radioactivity which potentially could cause considerable damage to the local population and environment. However, closure of this plant would have a severe economic impact on the community. We train and educate Rockwell employees, both at the plant site and at the college, in the most recent theories and techniques available to protect themselves, others, and the environment according to State and Federal regulations. This partnership has been very beneficial to both parties; we hire several Rockwell scientists as adjunct professors, and at present have approximately 50 employees registered as students. Rockwell compensates these students for tuition, books, and fees. In turn, we are training a workforce that will protect the health and safety of the community and upgrade our national security.

We feel we are meeting many community, state and local needs by:

1. Training people including women and minorities so they can be gainfully employed.
2. By providing trained people for hard-to-fill jobs in industry, business and government.

In addition, our long range goals are to:

* Provide a model curriculum for other community colleges and universities to use in developing similar training programs.
* Provide services to small businesses that use and produce hazardous wastes and information about legally-safe procedures and appropriate recycling and disposal methods.
* Promote national and community awareness of the environmental issues and regulations relating to the production, treatment, recycling, and disposal of hazardous materials and wastes.

Should we cut back technical education and enroll more anthropology, psychology, and sociology students in order to obtain proper funding for our college? I think not.

We have also created a showcase automotive lab with Ford Motor Company and adopted the Ford ASSET Technology program. Ford has donated and continues to donate over $350,000 a year in equipment and software for this technician training program. However, the curriculum is a technological curriculum that requires courses in math, computers, electronics, physics. While our Ford lab is impressive, our new student technicians enter antiquated science/math labs and are taught by dedicated professors who, despite their considerable talents, are badly handicapped by outdated equipment. The partnership with Ford is to train automotive technicians -- not to update biology or physics labs. How does a college forge an alliance with a physics company?

Recently, we forged an alliance with the Unisys Corporation and developed the first computerized Unisys Literacy Lab in a higher education facility in the United States. Funding through Unisys and the State of Colorado helped

purchase this 20 terminal $100,000 lab. ESL students and illiterates, while learning to read, are simultaneously becoming computer proficient. However, one lab will not be enough to train the thousands of illiterates in our region. Literacy training is not a program and it is not vocational or technological. But it is important if we are to educate those who will become the workforce of tomorrow. Would NSF fund a literacy lab which is not a science program or a technology program? We need to rethink priorities, and see community colleges in the light of the populations they serve, which will dominate the workforce a decade from now.

The college has created a desktop publishing/technical writing program which utilizes state-of-the-art technology. These students must not only be proficient in communication but must have a strong background in science and math. As graduates they will be drafting our scientific articles and manuals in the future. Again, the program is an Associate of Arts degree which does not qualify for Carl Perkins funds nor for NSF funds but science, engineering, and math courses are essential if we are to educate these technical communicators.

Soon, we will be developing a Neurodiagnostic Program, a Cable/Telecommunications Management Program and many others which are dependent upon strong and viable science, math and engineering technology programs.

The college and IBM recently received the national AACJC/ACCT Keep America Working Award for our model business-education partnership. This project dramatically illustrates the need to integrate technical training with other instructional disciplines to accomplish effective retraining of the workforce.

In April of 1986, IBM directed its Boulder, Colorado site to change its mission from manufacturing to software development and systems support. Two thousand employees or two-fifths of the workforce were directly involved with this mission change, one of the largest workforce transitions ever attempted by IBM.

Early indicators showed that the difficult job changes thrust upon the employees were impairing their prospect for success. FRCC developed two unique courses in "retraining preparedness" and "career transitions" to overcome learning, attitudinal, and psychological barriers. We developed these courses to improve learning skills, self-management skills, self confidence, and the capacity to cope with change. Participation in these courses resulted in a highly successful transition of those workers to new positions. The college and IBM jointly conducted training in programming and systems development for these employees. Again, a marriage between technology and communication, science, and problem-solving competencies.

All the recent national reports talk about white collar and blue collar employees. I do not believe that those employees will continue to exist in a technological society. Won't we really have bright collar employees and new collar employees? Bright collar employees will be using their intellectual prowess to solve pressing issues, to develop new products, and to integrate disparate systems for a better tomorrow. New collar employees will have the cognitive ability and technological skill necessary for a more complex and competitive society.

Nearly 6,000 employees from companies in our community were trained during the last two weeks. Our customized training programs were designed in collaboration with business to address unique organizational and workforce

needs. We have upgraded 250 electronic technicians for AT&T; trained 125 new employees for the Gerry Baby Products Corporation because a manufacturing function conducted by Takata Corporation in Japan was moved back to Colorado; worked with Applied Films Lab, an industry leader in film coating and the manufacturing of related equipment, in designing quality control efforts and improved productivity; and many other companies. If we cannot keep pace with new technological equipment for appropriate hands on experience and application, we will continue to fall behind Japan, Korea, Germany and others in workforce development.

In summary, Mr. Chairman, America cannot build and maintain a world-class workforce without much stronger, undergraduate programs in mathematics, science and technology, particularly at the lower division level. Your bill is a large part of the answer. The NSF alone cannot drive such needs, such programs, but it could and should provide much stronger leadership in this direction. As you envision in H.R. 1170, far-reaching cooperation will be needed from industry and higher education -- particularly with community colleges, which have become the primary source of formal technical training and retraining for working Americans.

Community, technical, and junior colleges are more committed than ever to helping America realize a world-class workforce before the turn of the century. Yet our colleges, like most universities and senior colleges, find themselves less and less able to afford state-of-the-art equipment in many fields. It is the partnerships with industry, as we've shown, that often provide learner access to such equipment. Such partnerships are equally important too as a source of scientists and other specialists who provide instruction on the

cutting edge of applied technology. Properly programmed, such instruction elevates the quality of education from the lower division up through graduate education. Such possibilities illustrate the genius of your bill, Mr. Chairman. Thank you again for this opportunity.

VITA

of

CARY A. ISRAEL

PROFESSIONAL EMPLOYMENT EXPERIENCE

President, Front Range Community College — Westminster,Colorado
August, 1986-present — (9 miles north of Denver)
Responsibilities:

- planning, developing and implementing all operations of a multi-campus college with overall responsibility for delivery of quality education and training to 10,000 students in a service area of 890,000 residents.

Highlights of Selected Accomplishments

Ford Motor Company

FRCC selected as the 6th national site for a new program in automotive technology known as ASSET (Automotive Student Services Educational Training). This is a joint venture between Ford Motor Company, Ford and Lincoln dealerships in an eight state region, and FRCC.

Takayama College

Initiated the establishment of a sister college relationship with Takayama College in Japan. This is the first and only sister college arrangement between a Colorado College and a Japanese College.

IBM, AT&T, and US West

Developed management programs related to worker transition. Our Retraining Preparedness Program was customized to facilitate retraining of manufacturing employees for positions in administration, distribution and information processing. Since October of 1986 we have served well over 2,000 individuals in Boulder, Colorado; Austin, Texas; Bethesda, Maryland, and Palm Springs, California.

Gerico

Negotiated the first customized training project in manufacturing for Gerico-Takata Corporation. Gerico-Takata produces infant car seats, Snugli products, and Gerry baby products. The infant car seat line previously manufactured in Japan is now manufactured locally in Thornton, Colorado. Received the Outstanding Self-Instructional Product Award from the National Society for Performance and Instruction.

Hazardous Waste Technology

Developed the first Associate of Science Degree in Hazardous Waste Technology in the United States. After training, technicians will be able to help handle, store, recycle, transport, collect and dispose of hazardous materials. They will also collect and process computer data to retain and develop records and regulations.

Small Business Development Center

Initiated and assisted in obtaining federal Small Business Administration funds for the creation of fifteen Small Business Development Centers (SBDC) in the state of Colorado.

Colorado Foreign Trade Office

Assisted Governor Roy Romer in the opening of the first Colorado foreign trade office in Japan, November 1987.

Minority Enterprises

First college to become a member of Minority Enterprises, Incorporated (MEI). MEI is comprised of over 250 minority owned businesses who provide products and services via computer network system to business, industry and government agencies.

Classroom of the Future

Established an electronic classroom of the future which utilizes AT&T's audio-graphic computer-based interactive educational delivery system. This technology will allow the college to make contact with distant learners and to increase our teleconferencing capability.

Literacy Lab

Established in collaboration with the Unisys Corporation, the Governor's Job Training Office, and the Adams County Employment Center a 24 station computer assisted adult literacy lab. Front Range Community College has been designated a showcase Unisys ICON demonstration site for the United States.

* Board Trustee for Humana Hospital Colorado
* Board Trustee for Affiliated First National Bank, Westminster
* member of the MetroNorth Chamber of Commerce
* member of the Adams County Economic Development Council
* member of the Adams County Partners In Progress for development of the new Denver international airport
* Board Member of Empire Radio Stations - New York, Delaware, Pennsylvania and New Hampshire

Vice President of Economic Development, Des Moines Area Community College
1984-1986
Responsibilities:

-executed training for business and industry in central Iowa: administered $5 million of training to business and industry during 1985-1986 (served over 93 companies)

-directed all evening and district credit operations, continuing education and non-credit, cooperative education, and conference center

-directed the training projects of these major corporations: 3M, Greyhound, Pella Rolscreen, Deere Credit Services, Amoco Credit Card Center, Northwestern Bell, Firestone, Armstrong Tire, Equitable Assurance of New York, Ruan Transportation Corporation

-developed and incorporated the first business incubator in the state of Iowa - established November 20, 1985 as the Golden Circle Business Incubator

Dean of Arts & Sciences, Des Moines Area Community College
1982-1984

Responsibilities:
-directed, coordinated and implemented an effective instructional curricula within a department consisting of 4,500 students and 145 faculty/staff. Created and Chaired the first institution-wide Curriculum Commission and Chaired the transition from quarters to semesters.

HIGHER EDUCATION BACKGROUND

Iowa State University
graduate level courses in higher education

University of Detroit, School of Law
Degree - Doctor of Jurisprudence/Law Review Member

Michigan State University
Degree - Bachelor of Arts with High Distinction

Mr. WALGREN. Thank you, Mr. Israel. Appreciate that.

Let's turn to Dr. Kraft.

Dr. KRAFT. Thank you very much.

Mr. Chairman, the community colleges are very grateful for the vision and vigilant leadership you have long given to the need to help both undergraduate science education and the work force to meet the test of global competition.

I am President of the Community College of Allegheny County, serving the metropolitan area of Pittsburgh, Pennsylvania. I am also a member of the Urban Community College Commission of the American Association of Community and Junior Colleges and I am testifying today on behalf of the Joint Commission on Federal Relations of that association and the Association of Community College Trustees.

Mr. Chairman, the inadequacies of undergraduate science and engineering education and the role of the National Science Foundation are, we believe, part of a much larger issue, our economy's need for a world class work force.

The Secretary of Labor's Commission on Work Force Quality and Labor Market Efficiency will share its report with Secretary Dole and the nation on this year's Labor Day. American Red Cross President, Richard Schubert, chairman of the Commission, has stated, and I would like to quote him just for a moment:

"In addition to asking what can be done to help the poor, we are now asking how can we bring these people into the economic mainstream so we can take full advantage of all of the nation's human resources? Thus, we are focusing more than ever on the education, the training and the employment of the disadvantaged.

"The problem that business people have begun to notice is that some organizations are already having difficulty finding workers with needed skills. Some are having difficulty finding workers, period. If lots of firms are having trouble hiring the human resources they need, it's not just a problem for each firm, it's the whole economy that's in trouble.

"America cannot compete in an increasingly competitive world if American firms can't obtain the people they need. If America can't compete, then our standard of living can't be sustained."

Mr. Chairman, if the National Science Foundation is to play a major role in meeting this challenge and make a comprehensive contribution to U.S. competitiveness, it must give leadership to more than post-graduate education in science and engineering.

Mr. Chairman, you're the author of legislation that would draw upon the NSF's know-how and leadership to help meet these challenges through industry/college partnerships that address the skill needs of emerging technology. As you know, this legislation, H.R. 1720, has the very active support of AACJC and ACCT. We urge you to continue to work for its passage.

Partnerships are essential to community colleges. Partnerships with State and local resources, with secondary schools and colleges and universities, local businesses, economic development agencies and public services.

Even now, these local partnerships are shaping the future of every metropolitan region in the nation, delivering training that is relevant to local labor markets and providing opportunity to stu-

dents who have been disadvantaged in the past by race, gender or wealth.

President Bush has called for a doubling of the NSF's budget over the next five years, and we applaud that goal and we urge your committee to earmark one-half of that budget growth or what would become 25 percent of NSF's total effort for improvement in undergraduate science and mathematics. U.S. competitiveness would be served to much greater advantage, we believe, by such a policy.

Community colleges serve more than 40 percent of the nation's total undergraduate enrollment. A majority of new workers in the year 2000 will have been educated at community colleges. Women and minorities, who ought to be graduate students in science and engineering in the 1990s, are in community colleges today, right now.

The four campuses of the Community College of Allegheny College served over 200,000 students just in the last three years. They enroll in programs ranging from basic skill instruction to highly skilled technician training, from university parallel education to customized job training. They make up nearly 40 percent of the black and female undergraduates, the older, part-time and new students who attend college in Allegheny County.

These students, the very population the NSF seeks to reach, I'd like to emphasize, are at the community college because it provides affordable, accessible, quality education. Tuition costs are less than half of those at public universities and one-tenth at private universities.

Let me share some of the programs in a moment that we do at Allegheny County that illustrate partnerships and their potential. We're educationally accessible. The community colleges develop the skills needed to equalize educational opportunity. We have articulated our programs with regional four-year colleges and universities facilitating transfers. We've linked our programs with local high schools, smoothing the transition to college learning, and our minority recruitment program has formed partnerships with local school districts and community organizations, developing in youth an early awareness of the importance of education to productive lives.

Community colleges provide accountable, quality education. We're retooling the American work force. In our own case, we've run the dislocated workers educational training program for over 6000 men and women during the peak of the so-called structural unemployment, and we continue now with what we call Workers in Transition, serving currently 1800 of the county's unemployed and another program we call Single Point of Contact, actively returning men and women on public assistance to the work force.

Active synergistic alliances with labor and industry have led to programs which provide skilled technician training. Partnerships with labor provide apprenticeship training.

Our General Motors partnership at our college is successful because General Motors approached the college with specific needs and the resources for program development. Now the partnership has expanded to include Ford Motor and other businesses.

We train almost all the auto service technicians in the county. We support regional economic development through customized job training. One particular industry, Shandon Industries, has moved to Allegheny County from Great Britain and because of this kind of partnership, started its operation in Allegheny County with a work force skilled to its specific needs.

I've told you what we do, community colleges in general, and the Community College of Allegheny College, in particular. I'd like to review at least what I understand to be several of the goals of the National Science Foundation and see how community colleges can become active partners in their realization.

The NSF seeks a systematic way to make a continuing investment in math, science and engineering education and not pursue a path of crisis stimulation. The community colleges are the most cost-effective, post-secondary institutions in the nation, and for the reasons we've stated, we think that community colleges ought to share in this investment. We can really help realize this goal.

NSF wants to promote hands-on science experiences and excellence at every level of education. Community colleges are active and they are experienced partners with high schools and colleges and universities.

We have young people and we have older people, where a focal point of efforts to develop excellence in math, science and engineering education at all levels for all people. We can really help meet that goal.

The NSF wishes to ensure a steady stream of people with math and science education, emphasizing youth and adults, women and minorities. Well, the success of community colleges here is measured in the disproportionate numbers of women, minorities, older adults and youth who attend community college classes.

If the National Science Foundation wants to reach these people, it must reach out to community colleges. That is where they are and I don't know who else could be a better partner for NSF than community colleges.

How do we do this? Well, first, we need community college leadership on the National Science Board. The Board lacks representation from the segment of post-secondary education that serves the majority of college freshmen.

Second, we need to become partners with the NSF. Community colleges work through partnerships.

Third, we need NSF leadership, an active commitment to all levels of math, science and engineering, and certainly we need this bill, H.R. 1720.

There is a unifying theme among our colleges today; that is, to develop a world-class work force before the turn of the century. We urge the NSF to view us as allies and not interlopers in this effort.

Through the community colleges, the NSF can tap into a wide network of partnerships with industry, State and local resources which will help to fuel this effort.

Again, Mr. Chairman, we thank you for your leadership in this effort and for this opportunity to testify before all of you today.

[The prepared statement of Dr. Kraft follows:]

Joint Commission On Federal Relations

AACJC

Testimony

on

Science and Technical Education at Two-Year Community Colleges

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by

Dr. John Kraft, President
Community College of Allegheny County
Pittsburgh, Pennsylvania

before the

Subcommittee on Science, Research, and Technology
Committee on Science, Space, and Technology
U.S. House of Representatives

April 11, 1989

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Mr. Chairman, the community colleges are very grateful for the vision and vigilant leadership you have long given to the nation's pressing needs to help both undergraduate science education and the workforce meet the tests of global competition.

My name is John Kraft. I am President of the Community College of Allegheny County, which serves the metropolitan area of Pittsburgh, Pennsylvania. I am also a member of the Commission of Urban Community Colleges of the American Association of Community and Junior Colleges, and I am testifying today in behalf of the Joint Commission on Federal Relations of the AACJC and the Association of Community College Trustees. Legislative policies and goals for federal programs are formulated by the Joint Commission in behalf of both Associations.

Mr. Chairman, the inadequacies of undergraduate science and engineering education and the role of the National Science Foundation are, we believe, part of a much larger issue. We think of that issue as our economy's urgent need for a world-class workforce. The challenge facing Congress and this Committee is to develop a policy and strategy that will produce such a workforce. Time is hardly on our side.

Ann Dore McLaughlin, the last of President Reagan's Secretaries of Labor, was the first and only member of that administration to call for such a strategy. We salute her vision. Fortunately, Secretary Elizabeth Dole shares the same conviction and now has a blue-ribbon panel of corporate executives, labor leaders, and scholars working to meet it.

The Secretary of Labor's Commission on Workforce Quality and Labor Market Efficiency will share its report with Secretary Dole and the nation on this year's Labor Day. American Red Cross President Richard Schubert, who chairs the Commission, has explained its mission in these terms:

"These days, a very different . . . theme is emerging. Now we are beginning to see the poor as a very neglected source of human resources. And we are beginning to see that we cannot afford to waste these human resources any longer.

"So, in addition to asking 'What can be done to help the poor?' we are now asking 'How can we bring these people into the economic mainstream, so we can take full advantage of all of the nation's human resources?' Thus, we are focusing more than ever on the education, the training, and the employment of the disadvantaged.

"I guess it's deeply rooted in human nature that we begin to take a problem really, really seriously when it affects us personally. Business people are not exceptions to this. . . . The problem that business people have begun to notice -- that has in fact galvanized everyone's interest -- is that some organizations are already having difficulty finding workers with the needed skills. . .and some are having difficulty finding workers, period.

"To make the whole matter even more binding, we're being told by the experts that the passing of the baby boom wave -- they're all working now -- along with the rapid aging of our whole population, means labor shortages on into the next century.

"So, the problem makes itself very clear: if lots of firms are having trouble hiring the human resources they need, it's not just a

problem for each firm. It's the whole economy that's in trouble. America cannot compete in an increasingly competitive world if American firms cannot obtain the people they need. If America can't compete, then our standard of living can't be sustained."

Mr. Chairman, if the National Science Foundation is to play a major role in meeting this challenge, if it is going to make a comprehensive contribution to U.S. competitiveness, it must give leadership -- strong leadership -- to more than post-graduate education in science and engineering. Obviously, it is Congress' responsibility -- not NSF's -- to determine what that role will be.

What community colleges see as a grave imbalance in NSF programming is illuminated in the trend among the so-called research universities and major schools of engineering to fill more and more openings in their doctoral programs with students from other countries. While such schools may see themselves in the role of "graduate school to the world," it is the States' taxpayers and the national interest that are paying the larger share of the cost. And we are not convinced that this is the taxpayers' preference.

President Bush has called for a doubling of NSF's budget over the next five years. We applaud that goal. We urge your Committee, Mr. Chairman, to consider earmarking one-half of that budget growth -- or what then would become 25 percent of NSF's total effort -- for improvements in undergraduate science and mathematics. U.S. competitiveness would be served to much greater advantage, we believe, by such a policy.

To make the point in terms of the budget requests for FY'90, NSF has asked for an increase of more than $200 million for research programs and an increase of just $19 million for undergraduate science and mathematics If a boost of $200 million is justified for research, an equal boost for

undergraduate programs is more than justified by the urgency of the global challenge to our workforce and our economy.

To attract more American women and minorities into graduate programs in science and engineering will require stronger programs for them at the lower-division level in both community colleges and state colleges. Recognizing that more than half the Americans who start college now are enrolling in community colleges, this should become a major focus of NSF programs. The chances that women and minorities will continue as science majors will be much greater if they are shown that they can master math and science in the freshmen and sophomore years.

Great numbers of women and minorities who ought to be graduate students in science and engineering in the 1990's are in the community colleges now. Community colleges serve more than 40 percent of the nation's total undergraduate enrollment, including majorities of the women and minorities. The populations that will comprise the majority of workforce entrants in the year 2000 are training or will train at community colleges.

Mr. Chairman, you are the author of legislation that would draw upon the NSF's know-how and leadership to help meet these challenges through federal participation in industry-college partnerships that address the skill needs of emerging technology -- legislation that drew more than 100 backers in the last Congress. As you know, such legislation has the very active support of AACJC and ACCT. We urge you to continue to work for its development and passage. We are more than eager to help you.

Partnerships are essential to the community college mission -- they facilitate the lynchpin role community colleges have come to play in American postsecondary education. Community colleges personify the creative partnership

of state and local public resources -- a partnership from which (except for student aid) the federal government is largely absent. Community colleges link secondary schools and colleges and universities through meaningful and articulated student mobility up the community college "ladder" -- making postsecondary education accessible in cost, quality, and location to the nation's most disadvantaged populations.

Community colleges respond to local need through partnerships with local employers, economic development agencies, and public services. Even now, these local partnerships are shaping the future of every metropolitan region in the nation -- by delivering training that is relevant to local labor markets and providing opportunity to students who have experienced disadvantages of gender, race, or wealth in the past.

Let me share with the Committee some of the programs the Community College of Allegheny County has going in our region that illustrate these partnerships and their potential to serve more broadly the nation's pressing skill needs and, specifically, help to meet the stated goals of the National Science Foundation.

The Community College of Allegheny County serves the Pittsburgh metropolitan region. It has enrolled over 200,000 students in the last three years -- over 93,000 students last year alone. These students attended one of the college's four campuses or were instructed at over 200 locations throughout Allegheny County, in programs which ranged from basic skill instruction to highly-skilled technician training, from university-parallel education to customized job training.

Among these students, the community college enrolled nearly 40 percent of the Black and female undergraduates, older, part-time, and new students who

attended college in the county. For the most part, students attending the community college are the first college-bound generation in their family. These are the students who can add to the number of Blacks and women employed in the mathematics, engineering, and science professions. Congress has recognized, through the NSF, the need to seed the development of emerging technologies. We are asking today that you also recognize the need to train the workforce to use these technologies effectively and competitively.

It is important that we know why those very populations that the NSF seeks to reach with math and science education are in the community colleges. It is because community colleges are affordable -- tuition costs are less than one-half those of public universities -- one-tenth those of private universities. They are commuter colleges -- making fewer demands on limited family resources. In Pennsylvania, community colleges serve students whose average family incomes are only two-thirds the incomes of private college students and three-quarters those of public four-year college students.

Community colleges are educationally accessible -- providing compensatory, remedial skills that equalize postsecondary educational opportunity. The Community College of Allegheny County has articulated its programs with those of regional four-year colleges and universities -- facilitating the transfer of its graduates without the loss of college credits. It has linked its programs with local high schools -- smoothing the transition to college learning. Through its minority recruitment, retention, and transfer program the Community College of Allegheny County has formed partnerships with local school districts and community organizations to develop an early and wider awareness of the importance of college education to productive lives in

the 1990's and beyond. A pilot program of the Association of Community College Trustees, these efforts have had a dramatic effect upon minority enrollments at the college.

The community college provides accountable quality education. Through partnerships with regional employers, economic development agencies, and local public services, the Community College of Allegheny County has developed a wide range of programs that prepare skilled workers for existing and developing local jobs. Some of these programs serve broad social needs. In partnership with Allegheny County, the college's dislocated workers' educational training program (DWETP) trained and returned over 6,000 men and women to the local workforce. In partnership with the State of Pennsylvania and the county, the college's current Workers in Transition program has 1,844 of the county's unemployed enrolled in retraining efforts. The college's single point of contact program is a partnership between the college, the county and the state departments of public welfare and employment security. This program is actively returning men and women on public assistance to the county workforce.

Some of the college's programs serve specific employment needs. Community colleges have pioneered partnerships with labor unions to provide apprenticeship training. Active synergistic alliances with national and local businesses have led to highly successful programs which provide skilled technicians with productive work futures. The General Motors partnership resulted from the corporation approaching the college with specific needs and the resources to support program development. Presently the college trains nearly all the technicians servicing General Motors products in the region. This partnership has expanded recently to include Ford Motors, other auto dealers, and auto service businesses such as Boron Procare.

This model program has spurred college efforts to develop customized job training in support of regional economic development. Companies seeking to relocate into southwestern Pennsylvania meet with college staff to develop programs which prepare their workforce. Shandon Industries relocated to Allegheny County from Northern Ireland and, because of this partnership, began its operations with a workforce skilled to its specific needs.

I have told you what we do -- all community colleges and the Community College of Allegheny County in particular. Let's review the goals of the National Science Foundation and see how community colleges can become active partners in their realization.

The NSF seeks to develop a systematic way of making a continuing investment in math, science, and engineering education and not continue a path of "crisis stimulation." The community colleges are the most cost-effective postsecondary institutions in the nation. For the many reasons we have discussed, the nation needs them to share in this investment.

The NSF wants to promote hands-on science experiences and excellence at every level of education. The community colleges are active and experienced partners with high schools, employers, and four-year colleges and universities in the delivery of accountable, quality postsecondary education. They are the essential focal point of efforts to develop excellence in math, science, and engineering education.

The NSF wishes to ensure a steady stream of people with math and science education, emphasizing youth and adults, women and minorities. As I emphasized above, the principal mission of the community colleges is to provide the widest possible access to postsecondary education. Their effectiveness in this mission is measured in the disproportionate numbers of women, minorities, older

adults, and needy youth who attend their classes. If the National Science Foundation wants to reach these people -- it must reach out to the community colleges -- that's where they are.

How do we begin? First, we need community college leadership on the National Science Board. We are troubled that this board lacks representation from the segment of postsecondary education that serves the majority of college freshmen. Second, we need a partnership -- community colleges do their work through partnerships. The NSF cannot drive these programs alone -- but it needs to provide much stronger leadership, to evidence an active commitment to all levels of math, science, and engineering education.

There is a unifying theme among our colleges today -- the desire to help America realize a world-class workforce before the turn of the century. Through the community colleges, the NSF can tap into a wide network of partnerships with industry, state, and local resources which will help to fuel this effort. From this network can come access to state-of-the-art equipment and faculty who are necessary to realize this goal.

Again, Mr. Chairman, we thank you for your leadership in this effort and for this opportunity to testify.

Mr. WALGREN. Thank you, Dr. Kraft, we appreciate that testimony.

Mr. Willis.

Mr. WILLIS. Thank you, Mr. Chairman. It is a pleasure to be here with your committee today and talk a little bit about TVA, Tennessee Valley Authority, and about our development partnerships that we have with junior and community colleges and industries in our area.

TVA is probably known as one of America's largest producers of electricity. We also manage the nation's largest managed river system. It is the fifth largest river in the nation and we carry out a wide range of other resource development responsibilities for the seven-State region and demonstrations for the nation.

We have become vitally interested in the last several years in improving our region's human resources, as well as its natural resources. During this process, we have become strong supporters and partners in the work of the two-year colleges and we have become very cognizant that education and job skills training go hand in hand in contributing to the economic livelihood of our region and the quality of life of the people who live there.

Job training skills is becoming one of the biggest economic development challenges facing the Tennessee Valley. I read just last week a poll of 150 business people and industry leaders and the State of Tennessee have ranked this as the number one problem that they have facing them in the State. Technology is changing at such a rapid pace today that virtually all of the people in the Tennessee Valley's work force will have to undergo retraining several times in their careers, but for those who lack the fundamental reading and writing skills, retaining will be extremely difficult, if not impossible, without help, for those who find themselves left behind.

Now, an estimated three-fourths of the people in the region today who are unemployed can't be readily retrained for the new jobs because they lack basic reading and writing skills. To give you an example of this, a manufacturing company was faced recently with having to convert its technology to meet new industry standards, but before it could complete the change-over, the company realized it had to retrain its employees and asked a local community college for help.

The college conducted a basic learning skills test to determine the extent of the training needed so they could tailor the program for it. The test was a very simple test. It had simple questions about arithmetic and reading and it only took 70 answers out of 116 to be considered passing. But only 29 of their 261 employees passed. Unfortunately., that doesn't appear to be an isolated example in our region, or indeed, in the country.

At TVA, we are very concerned about the problems that this and similar companies face and we have been working with our community and junior colleges to help solve those problems.

One of our most successful efforts is a reading program we're cosponsoring at Itawamba Junior College in Tupelo, Mississippi. The program was originally developed for grade school students, but we convinced the company that developed it to adapt it for adult use. The basic tools in the program are computer and laser videodisc,

which looks like an oversized PC, words and letters are displayed on a screen in a story format and the sounds are received through the earphones.

A student interacts with the computer, either through a keyboard or touching a terminal screen. They learn not only how to read, but also how to use a computer, which can be quite valuable when they move to the next stage of job skill training.

In fact, adult literacy is only one part of a comprehensive program to raise the education levels and job skills of the Tupelo work force that we're working with there in Mississippi. Until the late 1970s, most of the equipment in Tupelo's industrial plants was manually operated. When automation arrived, it came on at a furious pace and a number of plants were on the verge of closing or leaving the area where they could find more skilled labor for their new products, for their new technologies.

We were asked to come in and offer some technical assistance and help them, and we immediately turned to the local community college for assistance. TVA and the community college worked with local industries to find out what their problems was—were and to help develop and meet their needs.

The result is a Tupelo model for technical career development, and it is a comprehensive program that offers literacy and adult basic education training, along with advanced technical training in specific job skills and the principles of technology precisely.

The industry and the State pay for that program with support from a local private foundation. The program there has helped create about 2600 new jobs and helps explain why Tupelo has added more than 2 million square feet of new manufacturing and distribution floor space during the past two years. The fact is that the program has been so successful that at least 15 similar programs have been started elsewhere in the Tennessee Valley region.

We conducted a related program at Copperhill, Tennessee, where the Tennessee Chemical Company closed down its mining operations last year. The company asked for TVA's help in retraining copper miners who were being laid off. It was about 900 of them. With the funding from the State and from the industry, TVA immediately enlisted the help of several two-year colleges in the area.

Our goal was to put the workers through basic learning programs and then them retrained in new job skills. Many of the people who enrolled in the programs received a year's worth of training at community college. One program was designed to work with people who were basically illiterate and lacked job skills, to bring them up to a level where they could work as technicians in electrical and mechanical and computer fields.

As a result of the project, most of the workers who lost their jobs have been placed in new occupations and they are earning an average of $9 an hour.

We are also working with community colleges to demonstrate pilot programs in such fields as microelectronics, laser optics and telecommunications. The most comprehensive of these new high-tech curricula is a program called the "Factory of the Future," offered at Chattanooga State Technical College in Chattanooga, Tennessee.

Chattanooga State's "Factory of the Future" is, we believe, among the most advanced automated manufacturing training programs in the country and is supported through State funds, tuition and help from a local foundation and supported very actively by the industries in that area. Nearly 200 men and women have completed that program now, graduating with associate degrees, and all of them have gone on to additional training at four-year institutions or have obtained jobs of starting salaries from 20- to $30,000 per year.

Now, this "Factory of the Future" has been replicated at several sites across the nation, and has become a part of the advanced technology center movement that is going on in the community and technical colleges that is being supported as a way to attack the nation's economic ills in skill development. We are very intricately involved with that program and sense that that is one of the keys to meeting the challenges that you gentlemen have been talking about today.

These are just a few representatives of the skills development programs that we're sponsoring in cooperation with our junior colleges across the region and the success of these programs is a large measure the result of the cooperative effort of education, government, business and industry, and I can't emphasize too strongly of how that partnership plays a key role in this. All of these entities have to be intimately involved.

We've shown, we believe, that these partnerships can work and they can become a permanent part of our education system in the Tennessee Valley and they will work elsewhere in the nation as well. We know that if we're to succeed in preparing America's work force to meet and beat competition in a global economy, it'll take all of us, working together in these type of partnerships, but the ultimate success, Mr. Chairman, depends on the quality of basic science and mathematics in our undergraduate curricula.

If we're going to compete globally, we've got to raise the quality of science education right here at home, and we can achieve a great impact of working with the two-year colleges. They have to take remedial problems out of our high school systems, secondary—primary and secondary schools—and work with them. They have to retrain our work force; at the same time, turn out the quality product for the student that's doing well in high school and can move through that program in a hurry. They are serving a great need for our country today.

I don't know what would have happened in our country in the last few years if these gentlemen here that run these programs hadn't been able to step to the forefront and help us retool our work force. We would've been just left out at the economic table around this world, I am afraid of that.

They have a tremendous job to do in the future. It has been pointed out today here that the preponderance of our work force will have to be trained in these institutions in the next two or three decades and that's going to take—test all of us to how we can get the resources to them. They know how to do the job; they're equipped to do it from a faculty and know-how standpoint; they just need the assistance of industry and government to help them get the job done.

I appreciate being here with you to share some of our experiences.

[The prepared statement of Mr. Willis follows:]

TESTIMONY BY W. F. WILLIS, CHIEF OPERATING OFFICER
TENNESSEE VALLEY AUTHORITY
BEFORE THE SUBCOMMITTEE ON
SCIENCE, RESEARCH, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
APRIL 11, 1989 WASHINGTON, D.C.

Thank you, Mr. Chairman. It's a pleasure to be here today. And on behalf of the Tennessee Valley Authority, I appreciate this opportunity to talk to you about our skills development partnerships with community and junior colleges.

TVA is probably best known as one of America's largest producers of electrical energy. But we also manage the nation's fifth largest river system, and we carry out a wide range of other resource development responsibilities for our seven-state region and the Nation. And we're vitally interested in improving our region's human resources as well as its natural resources.

Over the years, we've become strong supporters and partners in the work of two-year colleges. We recognize that education and job skills training go hand-in-hand in contributing to the economic livelihood of the region and the quality of life of the people who live there.

Job skills training is one of the biggest economic development challenges we face in the Tennessee Valley. Technology is changing at such a rapid pace today that all of the people in the Tennessee Valley's workforce will have to undergo retraining several times in their careers. But for those who lack fundamental reading and writing skills, retraining will be extremely difficult. Without help, those people will find themselves left behind. Even now, an estimated three-fourths of the people who are unemployed in the Tennessee Valley can't be readily retrained for new jobs because they lack basic reading and writing skills.

Recently, a manufacturing company in Tennessee was faced with having to convert its technology to meet new industry standards. Before it could complete the changeover, the company realized it would have to retrain its employees. The company asked a local community college for help, and the college conducted a basic learning skills test to determine the extent of the training needed. The test consisted of a series of simple questions in arithmetic and reading. Although 70 correct answers out of 116 was considered passing, only 29 of the 261 employees passed. And that doesn't appear to be an isolated example.

At TVA we are concerned about the problems that this and similar companies face, and we've been working with community and junior colleges to help solve those problems. One of our most successful efforts is a reading program that we are co-sponsoring at Itawamba Community College in Tupelo, Mississippi.

The program was originally developed for grade school students, but we convinced the company that developed it to adapt the program for adult use. The basic tools are a computer and a laser videodisc, which looks like an oversized CD. Words and letters are displayed on a screen in a story format, and sounds are received through earphones. The student interacts with the computer, either through a keyboard or by touching the terminal screen. Students learn not only how to read, but also how to use a computer, which can be quite valuable when they move to the next stage of job-skill training.

In fact, adult literacy is only one part of a comprehensive program to raise educational levels and job skills of the Tupelo labor force. Until the late 1970s, most of the equipment in Tupelo industrial plants was manually operated. But when automation arrived, it came at such a furious pace that a number of plants were on the verge of closing. The owners considered moving to other locations where a more skilled labor force could be found.

TVA was asked to step in, and we called on the local community college for assistance. TVA and the community college worked with local industries to find out their problems, and we helped develop programs to meet their needs. The result is the "Tupelo Model for Technical Career Development," a comprehensive program offering literacy and adult basic education training along with advanced technical training in specific job skills. Industry and the State pay for the program with support from a local foundation.

The program has helped create about 2,600 new jobs, and helps explain why Tupelo added more than two million square feet of new manufacturing and distribution floor space during the past two years. In fact, the program has been so successful that at least fifteen similar programs have been started elsewhere in the Tennessee Valley region.

We conducted a related program at Copperhill, Tennessee, where the Tennessee Chemical Company closed down its mining operations. The company asked for TVA's help in retraining copper miners who were being laid off. With funding from the State, TVA immediately enlisted the help of several two-year colleges in the area. Our goal was to put the workers through basic learning programs and then get them retrained in new job skills.

Many of the people who enrolled in the programs received a year's worth of training at a community college. One program was designed to work with people who were basically illiterate and lacked job skills, to bring them up to a level where they could work as technicians in electrical, mechanical, and computer fields. As a result of the project, most of the workers who lost their jobs have been placed in new occupations, and they are earning an average of $9 per hour.

TVA is also working with community colleges to establish pilot demonstrations in such fields as microelectronics, laser optics, and telecommunications. The most comprehensive of these high-tech curricula is a program called "The Factory of the Future," offered at Chattanooga State Technical Community College. Chattanooga State's "Factory of the Future" is among the most advanced automated manufacturing training programs in the United States. It is supported through State funds, tuition, and help from a local foundation. Nearly 200 men and women have completed the program, graduating with associates' degrees. Almost all of them have gone on to additional training at four-year institutions or have obtained jobs with starting salaries ranging from $22,000 to $30,000.

These are a few representative examples of the skills development programs TVA is sponsoring in cooperation with community and junior colleges across the region. The success of these programs is in large measure a result of the cooperative efforts of education, government, business, and industry. We've shown that these partnerships can work. They have become a permanent part of our education system in the Tennessee Valley. And they will work elsewhere in the Nation as well. If we're to succeed in preparing America's workforce to meet and beat the competition in the global economy, it will take all of us working together in partnership.

But the ultimate success of these efforts, Mr. Chairman, depends on the quality of basic science and mathematics in our undergraduate curricula. If we're going to be globally competitive, we must raise the quality of basic science education right here at home. And we can achieve a great impact in the two-year colleges.

Community and junior colleges serve more than half or our citizens who are beginning college today. These schools are the starting point for many of the technicians, scientists, and engineers who will help America meet the great challenges that lie ahead of us in the 21st century. In many respects, the future of our country depends on them. Thank you.

# # #

Mr. WALGREN. Thank you very much, Mr. Willis, appreciate that.

Knowing—from the Pittsburgh area—knowing the difficulties that our work force had in the real industrial slowdowns and seeing the retraining that your region has done, Mr. Willis, and yours, also, Mr. Israel, comes the question of—of—I guess a sense of balance in retraining.

One thrust is retraining somebody with specific skills for a specific job, I gather. It makes him employable and you've taken copper miners and re-employed them in $9-an-hour jobs, and others have taken workers who lost jobs in one area and have redirected them and with specific company-based, in some instances, training programs, got them going in that company.

But what about the skills that will enable them to grow in that job or adapt if that job ends? Somewhere along the line, somebody said that some Japanese operations don't want to come to use American workers, because as far as they're concerned, American workers can't think on the level that they feel somebody connected with statistical quality control and understanding numbers, apparently—or what numbers mean in a manufacturing process—if they don't have the background to do that, then no matter whether they are trained to fill the job that's immediately open, if that job goes down, then there's another untrained situation we have to deal with.

How do you balance the ability of people to keep learning, I guess it is, versus the specific job training that is so demanded by communities in the depths of a downturn?

Mr. ISRAEL. I'll be glad to answer that. We did that with IBM Corporation. One of our courses was retraining preparedness to get them ready to be trained. A lot of them—some of them have master's degrees; some no degrees. They have been doing the same job function for 10 years.

The other whole sequence—there's a series of courses we call career transitions to address exactly what you're saying, that we wanted a whole-brained individual because IBM thought, and wisely so, that these individuals might again need to be retrained and we have put them through all different types of courses. Even if they had a master's degree, they came back and took some physics, programming fundamentals courses and math courses to have better cognitive ability.

So we are now integrating that type of curriculum into our training projects, but unfortunately, you know, we don't get reimbursed from the State. We are based on FTE or full-time-equivalency enrollment and we get reimbursed if we have an extra psychology, sociology, anthropology student. We don't get reimbursed for a retrained student. So it is on a cost-recovery basis.

But if we change the whole focus of our institution toward economic development and customized training to make that competitive work force, we'll be out of business because we won't have enough funding to do so. With a corporation like IBM, they do have adequate resources to compensate us with a little bit of of margin for running these two-year long customized courses.

But we can't do that with small business because they don't have the resources. Another good response is Ford Motor Company gives

us half a million dollars a year. If all of us would take our cars to the dealerships right now to get fixed, there's only 20 percent stall space left in this country. That means 80 percent of us would have to go to an independent garage owner. Independent garage owners don't have a half million dollars to pay for new equipment, pay for getting their mechanics to become really technicians. So what's happening is that they're not getting retrained.

Mr. WALGREN. Let me ask any other comments on that and then I have—sort of thinking of a follow-up.

Go ahead, Mr. Kraft.

Mr. KRAFT. I'd like to comment on that, too.

I think the question is a good one, but I think for any individual at any given time, the answer may be a little different. It's a conceptual kind of question, but as we know throughout the history of my community college, sometimes we do hands-on training and sometimes we do something more complete. It depends on the needs of the individual; it depends on the economic needs of society as a whole. I think that the point is that we're there for whatever is called for at the moment, and at the moment, some individuals may need a longer, more generalized program to bring their thinking skills, to hone their reasoning powers and so on up to par, and at other times, it might be very specific.

Mr. WALGREN. I guess what I'm trying to look for here is what's not there. Now, I hear you all saying, "We're there," and that's true. I mean, you are physically there, and you're trying to meet the needs as they're thrown at you, but what needs are unmet?

Mr. Israel says, "Well, look, we don't need that much help with curricula."

Mr. ISRAEL. We don't.

Mr. WALGREN. "We don't need that much help with teacher enhancement." As far as he is concerned, they're ready to be able to teach whatever seems to be helpful at this point and there's some physical needs, some laboratory needs, some equipment needs, but essentially they're there—not they are there. Those are unmet needs, but essentially, you are there.

I guess what I'm asking you, what's not there? What would you like to see us trying to add that is not there now?

Mr. WILLIS. I'd like to comment on that.

Mr. WALGREN. Mr. Willis.

Mr. WILLIS. One of the things that we've tried to do in working with companies on retraining and working with the junior colleges is offer something broader than just retraining a person how to do something counterclockwise when they did do it clockwise before.

You're absolutely right, they're going to have to change again next year, and that won't get us anywhere down the road like we need to be. We have to train people now in the work force to get some high school, basic type high school science and math type theory in their head as well as principles of technology.

That's the ingredient that I find missing. We do a good job in teaching basic science and math, but that doesn't carry us far enough in the workplace today. We need model laboratories in this country and model programs to teach us how to teach principles of technology as we retrain our work force, so they can change from

one type of technology very quickly as technology changes in the workplace.

That person has to have those kinds of skills to do that and we tried some demonstration programs and people take to that very quickly, but to have to get—go back and get some basic science and math and communication skills and move into principles of technology so the new electromechanical technologies and things that are coming along today—they have to understand those and that's what's missing in the—in the equation that I find.

Mr. WALGREN. Mr. Israel mentioned, I think it was, that in a sense one role is to make the work force ready to be trained.

Mr. WILLIS. Right, absolutely.

Mr. WALGREN. Now, then, my question is, what's missing in that area? Do we have the kinds of courses now present that meet that in the best way from your perspectives or is that yet to be developed?

Mr. KRAFT. I think—I think that there are—there are a number of needs. One of the things, I think, that we're getting into now with this question has to do with support services. We really operate on a shoestring all the time. I think we do an excellent job with what we have. I think probably one of our favorite expressions is you get more bang for the dollar at a community college.

However, we don't really have the wherewithal to put on as many remedial courses as we'd like. We don't really have the wherewithal to give a whole variety of support services that we should be giving to an awful lot of students. We think we do a good job there, but we're doing special work now with recruitment, retention and transfer for minority students, and when we started this project two years ago, we really did it on a shoestring. We're depending on volunteers.

We've got one person assigned to this full time. We could probably use six or eight full-time, in addition to the one we have now. We need more laboratory equipment; we need more of everything to support these kinds of programs.

Mr. WALGREN. You need more. How do you view the structure of those remedial programs? Are they as effective as they possibly could be? I guess what I'm thinking of is the chemistry people came in and they said, "Here we, as an industry, came up with this Chem-Comm course," or whatever it was, and it was a very special high school-level course that was very interesting in the way it was framed and directed.

I am wondering, if I walked into a remedial course in the community colleges that was trying to teach a 12th-grade person who might have missed some stuff along the way and trying to train them to be ready to be trained, would they find an engaging, focused and extremely relevant course there for me? If they do, my guess is that each of you has created this out of whole cloth in your own communities.

I may be wrong about that, but—but I hate to think of the idea of all the community colleges in the country having to try to invent what that ought to be.

Is that where we are or are we farther than that?

Mr. ISRAEL. We have a principles of technology course that we integrated into our curriculum last year for, again, "all those occupational"—

Mr. WALGREN. Where did that come from?

Mr. ISRAEL. It was—it came from the State level and a combination of all the community colleges getting together to develop that course under a small grant, like real small, $5000 for the entire State, so it came from a lot of talking with the secondary schools and talking with the community colleges and the universities and created a course called "Principles of Technology."

It's a good course, but again, the problem becomes when that physicist wants to demonstrate something, he or she doesn't have the tools to demonstrate or apply that new technology. How can a person have hands-on experience if we don't have the equipment?

So I think the curriculum is there. We—

Mr. KRAFT. I'd like to interject, though, Mr. Chairman, that when it is there, there is no systematic regular way of finding out about it.

Mr. ISRAEL. That's true.

Mr. KRAFT. We—we just do it kind of ad hoc all the time, people like Mr. Israel and I meet here today, exchange business cards, maybe call one another on the phone and say, "Would you send me a copy of that program?" That's one way it happens.

Another way it happens, interestingly enough, is a—an organization like General Motors or Ford actively seeks us out and they help to create a network, but generally speaking, I know of no regular systematic organized way for us to share in this curriculum development and I think that that's something that's very much needed.

Mr. WALGREN. My time is expired and I want to turn to my colleagues, but only—if they would indulge me one little anecdote, and that's what I fear might be happening for community colleges trying to meet these responses.

I taught a course one time in law to high school seniors, and I made that course up out of my own bedroom. It started with one of these—the books with the shiny pictures on Alaska and some anecdotes out of that and how you develop the law out of wilderness.

But the point of it is is that I made it up, and that's not the right thing to have happen to those high school students that I taught, nor is it the right kind of thing to have happen to individual community colleges around the country if they're having to create these things out of whole cloth in response to their immediate community need.

I apologize for taking time.

Mr. Boehlert.

Mr. BOEHLERT. Where do I sign up for the course?

[Laughter.]

Mr. BOEHLERT. Mr. Israel, is Front Range part of the State university system?

Mr. ISRAEL. No, it's a State community college system. It has a State-run board. The State board controls all the community colleges in the State. It's not part of the university system.

Mr. BOEHLERT. Your principal funding comes from the State, is that—

Mr. ISRAEL. That's correct.

Mr. BOEHLERT. Is it a 50/50 match, State and local?

Mr. ISRAEL. No, no local. It's all State.

Mr. BOEHLERT. Generous in Colorado.

Mr. ISRAEL. Yes.

Mr. BOEHLERT. Do you have open enrollment?

Mr. ISRAEL. Yes.

Mr. BOEHLERT. How about you, Dr. Kraft? Is Allegheny open enrollment?

Mr. KRAFT. Yes.

Mr. BOEHLERT. What percentage of time of the faculty and students would you say in your two institutions are spent on remedial education?

Mr. ISRAEL. In my institution, before I got there, about 15 percent. Now that I've been there, we, again, put some programs together, about 30 percent of their time.

Mr. BOEHLERT. How about you, Dr. Kraft?

Mr. KRAFT. I don't—I'd be a little hesitant to give you exact statistics, but I do know, when—it varies from time to time and with group to group.

When we—I referred in my testimony to the structural unemployment and when we took large numbers of people from steel mills that were closing and so on, at that point, 70 percent needed some kind of remedial education before they could get into one of the regular programs.

Mr. BOEHLERT. How about if we just talk exclusively about recent high school graduates coming to Allegheny.

Mr. KRAFT. I'd estimate 40 percent.

Mr. BOEHLERT. That's a sad commentary on our public school system, isn't it?

Mr. KRAFT. You have to understand, when you talk about the people who turn to community colleges for help, recent high school graduates are also the smallest percentage of people we have. The average age of our students is about 29, and we get high school graduates from 10 years ago, 20 years ago and so on in greater numbers than we do recently.

Mr. BOEHLERT. That's the new student of today, isn't it?

Mr. KRAFT. Yes.

Mr. BOEHLERT. We heard testimony in a hearing we had in full Committee this morning from a representative, Dr. Packer, from the Hudson Institute, indicating that there are like 25 million people in this country, aged 21 to 25, that need some sort of retraining right now to be gainfully employed.

Mr. KRAFT. Sure.

Mr. BOEHLERT. How would you characterize your relationship with the National Science Foundation at present?

Mr. ISRAEL. Poor.

Mr. BOEHLERT. Dr. Kraft?

While you're thinking about it, amplify on that, please.

Mr. ISRAEL. Well, when we—I thought it was kind of unique for national security and also for keeping a work force employed, over 6000 people, I believe, at the Rocky Flat facility, that we know we're going to have to clean up that Superfund site, to create a model curriculum comprised of government people, State and Fed-

eral, business and industry leaders, DOE, EPA, EDA, to submit grants twice to NSF to hire a special consultant to—knows how to write the grants and submit them and still to be denied any type of funding in a new, unique program for the entire United States—says something to me about maybe some of their priorities on what we're attempting to do.

Mind you that I said 30- to 32 percent of all the students in that program already have a bachelor's degree, so we are retraining the college-educated individual into higher level jobs to protect our country and to clean up in our environment. So I found it to be—I couldn't think of any more unique program to be funded that was totally science-based, and went out and hired the resources and still got a form letter back twice, saying—

Mr. BOEHLERT. Excuse me, do you think if you take—take that same set of circumstances—

Mr. ISRAEL. Uh-huh.

Mr. BOEHLERT. —the same idea, everything else the same, but you substitute Harvard or Stanford for Front Range Community College, what do you think the response would have been?

Mr. ISRAEL. If we added a little research component, it would've been funded.

Mr. BOEHLERT. Dr. Kraft, how about you?

Mr. KRAFT. Well, I think that I would—I would say I have the opinion that NSF thinks it's enough to say anyone may submit a proposal. I think that that's not enough.

When General Motors comes to us and says, "We want a partner to help us reach our goals and solve our problems," they come to us in a proactive way and they say, "We want to share our scientific knowledge; we want to share our expertise; in fact, we want to share our resources because we know you're a good partner and you can help us do the job and reach the goals we want to reach."

So I think it's not enough for NSF to say, "Anyone may submit a proposal and you're more than welcome to do this at the community colleges and perhaps your proposal should be of higher quality." That's not the way for NSF to reach the goals that they state they want to reach.

I think that they should be much more proactive and they should be seeking ways to help us. I think that we—we're only scratching the surface in terms of trying to come up with this global work force and I think that the kind of bill that I referred to can accelerate this process. I think the kinds of things contained in that bill will enable us to work more and more with high-tech business and industry and share the kind of scientific knowledge that those people have and their know-how, and I think NSF can play a very, very large role in helping to do that and in helping us to serve the people of this country and tap this untapped group of people that NSF wants to tap: minorities, women and so on.

We have access to them; why not use us? And I don't think that's been happening.

Mr. BOEHLERT. Eighty-five percent of the entrants—new entrants in the work force by the year 2000 will be women or minority.

Obviously, we agree with what you've just said—this subcommittee—you're preaching to the choir. Under the chairman's very effective leadership, he's the one that—this is in the spirit of biparti-

sanship, Mr. Chairman—he's the one that's been leading the way, but it hasn't been a command performance because we voluntarily marched alongside him.

We believe in the community colleges and we want to make believers out of the key decisionmakers at the National Science Foundation, and I think they're coming along.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Boehlert.

Mr. Skaggs.

Mr. SKAGGS. Thank you, Mr. Chairman.

Mr. Israel, it seemed that you were alluding several times to some categorization and labeling requirements that struck you as arbitrary and capricious in their effect on your ability to get funding for the programs that you think are important. And I am wondering—wonder if you can elaborate on that a little bit, if you seem to be saying you've got to play a bit of a charade about what you're calling things; and secondly, what do we need to do to give the right kind of direction to the people that are creating those categories so that they reflect reality and give you the flexibility you need to be effective?

Mr. ISRAEL. Thank you.

We're creating new programs that are just beginning to exist in our society, not looking at some of the programs that already existed. We—which I didn't mention—have one of only 11 programs in the United States with technical writing and desktop publishing.

I think the program that's better than us out of those 11 is University of Rensselaer Polytech out of New York. That program, again—for us to get funding, we would have to call it an associate of applied science in order to computerize that particular curriculum. We didn't do that because it doesn't serve us well. Many of these technical writers or desktop publishers will go on to write scientific manuals for companies and they want to go on to further their education.

So instead of contriving the curriculum to get funding and—and programming people toward just a purely vocational degree, which they don't want in the first place, we program them for success if they want to go on beyond the two-year degree into the university, to the graduate programs, and we try to scrounge up the money in order to create the 100- to $150,000 lab that we need to educate those—

Mr. SKAGGS. Are these Perkins Act categories that need to be made more accommodating and, Dr. Kraft, have you had similar experiences?

Mr. KRAFT. Yeah. One of the problems I think community colleges have always had is there are longstanding enterprises and we're relatively newcomers to the scene, and I understand that many of these programs were created for a different purpose in a different time.

I think we have to recognize that times have changed and the needs of our population, the needs of our nation, are different now. And I've run into the same thing with vocational education moneys and so on.

Incidentally, perhaps as a partial answer to a previous question asked, I think that—I read someplace where NSF felt that perhaps

some of the kind of education and training we were doing would best be funded by vocational education and I just think we ought to reject that.

I think that we have to bring all the resources we can to bear and that's another thing I like about this bill, 1720, because that has a provision, I believe, calling for the cooperation of commerce and education and labor and all the resources that can come from Washington. I think we need them all and I—I think we shouldn't have to try to fiddle around with making things look like something else just to satisfy some guideline.

If we can help solve the problems, we ought to be welcome to try to do that.

Mr. ISRAEL. The bill, as introduced—I keep talking about large companies. I mean, we work with AT&T; we work with IBM. The curriculum support or the hazardous waste is there because there's a problem and we're dealing with it.

NSF could be very helpful in curriculum support for what's keeping this country great and that's small business. Just like Colorado, the bulk of the businesses that we're serving are small business, and again, it's very difficult for small business to come to the table and give us money for equipment or to help us spend a lot of time on curriculum.

So I think, again, this bill could be helpful in setting up a support system for small business development, as technology and transfer and application takes part. But again, I keep hounding on the same subject. It's very difficult to demonstrate good technology application or transfer when you don't have the lab or the facilities to do so.

We don't, even though we've been creating some marvelous programs. We've only trained 800 people through our Literacy Lab. Now, here's some technology that can take a person and move them up two grade levels in 20 hours on that machine. In 20 hours, they can go up two grade levels. They can take them all the way up to the 11th grade in 160 hours for a motivated individual. There should be no reason in this country why we have illiterates.

If we have the technology and the application there, not only are they becoming literate; they're becoming computer-proficient. Yet, you cannot get funding for a Literacy Lab because it's not vocational and it is not a National Science Foundation issue that they're going after.

So here we have wonderful technology that can make people read rather quickly to get them into the work force, yet we have to scrounge around for 100 and some thousand dollars in order to create one lab that has served 800 people in four months. We're not even doing a dent in the literacy problem—in the illiteracy program.

Mr. SKAGGS. Presumably, my thoughtful former colleagues at the State legislature in Colorado will hear you on that, I say advisedly.

Mr. Willis, and really on Mr. Israel's comment on the literacy problem, your testimony touched on that. Whenever I hear and start to think about the numbers that are involved in terms of the campaign for adult literacy in this country, it terrifies me. But I see—see that as as great a threat to our national security as such about anything looming on the horizon. What should be doing

there? What, as a consumer of the community and junior college product, would you assign—what part of that task would you assign there, as opposed to other resources we can bring to bear?

Mr. WILLIS. Well, I'd hate that any of that resource has to be assigned there at the junior college level, but unfortunately, that's where it's falling. They're getting remedial problems from our high school systems and they're getting the rejects from industry. And they have to deal with it.

That's why it's important to pick up on what Mr. Israel said about literacy training. We can't do it one-on-one type training. We have to employ new technology and that's the reason we—we need tremendous assistance to put into place the technology that we have available today.

In the last two or three years, with interactive video and laser disk technology, we can increase the learning process and learning to read and write by 10-fold from what we could just a few years back. We have to engage that type of technology to retool our work force and to get people qualified to go into the work force that are not qualified now.

We—I think it's a sad commentary in this country. We have some of the best research going on in our major research institutions and corporations in the country, but the other folks in the world are finding out quicker ways to move that technology to the work force than we are. They're training their people quicker than we are and we're not making the investments in technology transfer to the work force that we need to be doing.

We—we're just grossly deficient and appalling the types of things that people have come up with, even though they made it out of whole cloth themselves, as the chairman said. That's the only way we could get it done. We—of the 1200 junior colleges, probably 15- or 25 percent of them or maybe—in that range—are moving to the forefront with new technology, but a lot of others are struggling to try to catch up.

They need a lot of help because they can do the job if we'll equip them and if we will keep them to the state of the art of technology that's available. That's where we need to make Federal investments in these programs and have centers where we can have demonstrations put on that the—the rest of the junior colleges and community colleges can get up to speed.

That's—it's—we just not are making investments to move technology to the work force that we ought to be doing in this country, and it's hurting us. We've got a lot of people that are innovative that are coming to the forefront and showing us how to do this in several of the junior colleges across the country where they are fortunate to work with large industries, but the bulk of the community and junior colleges need additional assistance. They need Federal assistance in getting curriculum development. It's not as widespread as I'd like to see it in our region. They need a tremendous amount of help to keep the technology current.

One of the biggest problems, Mr. Walgren, that I see in our region with the 20 or so junior colleges that we work with is they can get a piece of equipment that's state of the art, and a year later, it's not. And they're training students on equipment that falls out of use very quickly in industry and they need centers

where they can keep the best state of the art equipment and best instructional material and training for instructors available to stay up with the rapid movement in technology.

You people on this committee know how fast that's moving, and that's one of the things that we're going to have to make tremendous investments on if this country—in this country if we stay abreast with what's happening in the world.

Mr. SKAGGS. Thank you, Mr. Chairman. I just ask you all to be patient. We're going to grow our way out of this budget deficit and then we'll be able to help you.

Mr. WALGREN. Thank you, Mr. Skaggs.

Mr. Slaughter.

Mr. SLAUGHTER. No questions.

Mr. WALGREN. Mrs. Morella.

Mrs. MORELLA. I appreciate your being here. This is one of the most important topics that we will be discussing with regard to science and technology, and I'm a product of—having taught at community college for 15 years and somebody from my faculty will be speaking later on—last one on the panel—but I'm curious about two things.

First of all, the whole concept of literacy. You're talking about basic literacy; you're not talking about mathematical literacy, scientific literacy.

Are there federal programs that exclude community colleges that deal with the gap in literacy? Because it seems to me that you've got a major problem in that there are many of the four-year colleges and the universities that might have standards that would exclude those people who have the problem with literacy, whereas community colleges are more apt to have an abundance of them.

Are there—anybody who wants to answer. I know Mr. Israel talked about literacy.

Dr. Kraft?

Mr. KRAFT. I don't know of any particular clauses that specifically prohibit the money flowing to community colleges. However—a great big however—but we are the fourth largest college in Pennsylvania, with about 22,500 full-time-equivalent students. I would estimate maybe 10 sections of general education development, adult basic education courses, are funded with Federal moneys, of the thousands and thousands of courses that are put on in Pennsylvania.

That money does not flow to community colleges, and I'd be hard-pressed to tell you exactly why, but there is something in operation, whether it's benign neglect or whether we are viewed as interlopers in someone's legislation, I just don't know what it is.

I am reasonably sure it's not because we're not aggressive in trying to get it.

Mrs. MORELLA. That's what I was going to ask. Does it mean that there are some things that you're not doing?

Anyone else want to comment on that? That may be an area we can try to look into further. Do you feel that whatever federal programs there are, you are able to avail yourselves of?

Mr. ISRAEL. Yeah, I think—you know, we've created numerous partnerships with a lot of companies in the last year and a half. I

would agree. I don't think there's any prohibition. I don't know why it's not coming here.

I know from a State perspective why it's not coming here. From a Federal perspective, I don't know. Again, it is better to enroll in most community colleges a person in a credit-type course, either general ed or occupational-specific, than in a generic thing like customized training or literacy.

Mrs. MORELLA. Sure. Which is why many companies are trying to come up with computer teaching of literacy on an adult level that might be able to fill in those gaps and keep back the inhibitions that one might have, reservations.

Secondly, I'm interested in what you've done to be able to attract women into science and math education. I mean, the—I know there's a need for minorities and I guess in this particular instance women are put into the minority category, but I think specifically they have felt that even though we've made a lot of headway in tearing down these so-called nontraditional jobs, which are no longer nontraditional, that's one area where somehow they do not—do not enter or they're not encouraged to enter. That also ties into the returning woman student, of which there is a great number.

Are they in the counseling told that they can do—that they can handle it?

Mr. ISRAEL. I'm glad you asked that question. We created a women's technological center. We have a women's centers at the college. Sixty percent of our 10,000 students are female, so we have a women's center to transition the women who have been out of education for a while or had been in the work force or what have you, and then we saw that the women were being mainstreamed again to those "typical" women occupations like early childhood education, so I created a women's technological center because, in our first Ford program, mind you, Ford pays for the students to go through it and other companies pay for their equipment that they need.

We didn't—out of 300 people that applied, we only allowed 25 and we had no women as candidates. In our second class, we had two women as candidates. They were screened out by the dealerships. One screened herself out, and we have some minorities now in that second class in Ford Motor Company.

So we thought it would be real important, going through that history, to create a women's technological center, which we did create, because a person who graduates from our technician program with Ford can earn immediately $40,000, because they have state of the art training.

So it's helping a little bit. We hired a woman to be in our—as the chair of our electronics program as a faculty member. Again, I think a role model was very important in bringing women into some careers that "weren't available" before for them. It's been a hard fight a little bit.

The hazardous waste program has great opportunity for women. Again, we don't see many coming in, but that's a good one to push women toward.

They're still going toward some traditional things. We have 610 people on a waiting list just to get into our nursing program and

we just created the first fast-track nursing program to take 32 mothers off of welfare and fast-track them to become nurses. Again, the biggest program with that program is that we don't have, again, the equipment for the science and math courses and the remedial courses that some of those welfare mothers need in a fast-track mode in order to get them ready to become a nurse.

Again, that's where NSF could help in—if we're going to—we have a critical nursing shortage in this country. We don't want people to be on welfare; they don't want to be on welfare, but the support system's not there, as far as the amount of remedial courses needed to get half of them through.

The other thing that wasn't there that we've created is there was no child care available. I mean, we haven't—we take children from six weeks all the way up to 10 years old on our campus, but at a little bit of a cost. We don't want to compete with the private sector and—because we are subsidized.

Our biggest problem with the fast-track nursing program is the first semester, it costs $53,000 for child care support. Now, if you take the short view, like some legislation does, it's very difficult to get a person remediated and fast-tracked as a nurse in a year. I mean, we're not going to do that and yet, our funding lasts for a year as far as for child care.

So, again, we have some problems in trying—and it's true with any of the other technological programs. Our hazardous waste program takes two years. It does not take six months or 10 weeks; it takes two years. And so, for a lot of those women, single parents, we went out and raised scholarship funds, but it doesn't even put a dent, again, in the amount of support they need to get them through those new technologies.

Mrs. MORELLA. Have you ever thought about doing a weekend college kind of thing? Friday, Saturday—

Mr. ISRAEL. We have classes on Friday night, all day Saturday. We even—I even brought in the church on Sunday and—so separation of church and State—they pay us good money and they baptize in our pool, so—

[Laughter.]

Mr. ISRAEL. We're covering all aspects at our college. We're not a college in a community; we're a community college. We're real accessible and we get great utilization out of the building.

Mrs. MORELLA. That's good.

Anybody else want to comment on what you're doing for—

Mr. KRAFT. Well, we have—

Mrs. MORELLA. —women?

Mr. KRAFT. We have many things similar to what have been described.

The problem with having enough support services—Mr. Israel's point—as far as I'm concerned, is very well taken in terms of most of whatever Federal aid is available under any bill or act or category, traditionally has really been aimed at getting people in and out as quickly as they can. The provider really gets the rewards by taking someone and putting them through a six-week program, and that's better than a year program, and a year program is better than two.

We're talking about a population, however, if we're really to tap the resources and the brain power of everyone in our community. We're talking about large numbers of people who need additional support services that we just can't give them without some more help.

And I really appreciate this point about we need the extra support services. You need child care centers and you need transportation and you need this kind of support in order for people to enroll and be successful in the programs.

Mrs. MORELLA. Should that come under the welfare bill revision amendment; should it come under National Science Foundation? How should that be—separate piece of legislation?

Mr. KRAFT. I think that—I chaired a special committee set up by the governor in Pennsylvania about a year ago to look into job training and retraining and one of the things that we discovered there was there was such a myriad of programming and the coordination is just honestly extremely difficult. Unless and until someone can come up with some super way of coordinating everything, I think we do the best we can.

One of the programs I referred to—we call it the Single Point of Contact—in which we're doing our best as an institution to bring in the Department of Labor and their counselors, to bring in the welfare people and their counselors to work with our own college counselors, to just bring everyone who traditionally tries to do something for, what, some decades ago, we called the forgotten Americans. We've tried to pool that all under one roof and make it as easy as possible for an individual to come and avail themselves of this myriad of services.

I think that as long as it is difficult for government agencies and organizations to provide this coordination, again, community colleges can and, in some cases, like the one I've just described, have some capability of doing this and if NSF would—would jump into the pool, not for baptism, but for helping these people, we'd be delighted to have that as a help as well.

We can make it synergistic; we can make two and two add to five, I think.

Mr. ISRAEL. All the programs that we're trying to create or the programs that are in need right now are science- and technology-based, so that once we might take them through that literacy component, what needs to be in place—what's not in place—is that science and technology background and the equipment, the facilities and the curriculum needed in order to make that person successful in her or his chosen occupation, vocation, now or in the next three to four years, and a lot of that is missing, again.

Mrs. MORELLA. I thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mrs. Morella.

Well, on behalf of our committee, we want to express our appreciation to you and look forward to talking with you and appreciate your being a resource to us.

Thank you very much.

Mr. ISRAEL. Thank you very much.

Mr. WALGREN. The second panel, Dr. Robert Watson, the Director of the Division of Undergraduate Science Engineering and Mathematics Education at the National Science Foundation—Dr.

Watson to describe the programs at NSF that relate to the two-year and community colleges, as well as the recent NSF report on the status of education at two-year and community colleges. Dr. Watson, joined by Dr. Daryl Chubin, Senior Analyst at the Office of Technology Assessment; Dr. Chubin to talk about some of the demographic changes and some of the roles that two-year and community colleges play in preparing students for further education.

We'll start with you, Dr. Watson. Welcome to the committee. Your written statement will be made part of the record, without more, and you can feel free to focus on parts of it if you choose to emphasize one point or another.

Dr. Watson.

STATEMENTS OF ROBERT F. WATSON, DIRECTOR, DIVISION OF UNDERGRADUATE SCIENCE ENGINEERING AND MATHEMATICS EDUCATION, NATIONAL SCIENCE FOUNDATION; AND DARYL E. CHUBIN, SENIOR ANALYST, OFFICE OF TECHNOLOGY ASSESSMENT

Dr. WATSON. Thank you.

I'd like to begin by expressing my appreciation to you, Mr. Chairman, and to the committee, for your continuing support and interest in the NSF as a whole, but in particular, the science and engineering education program.

As you've demonstrated in the past by your interest, the health of science education is key to our country's well-being. I believe this is true in degree as never before. Fortunately, never before have we had so much desire nationwide to see that our schools and colleges fulfill their promise of strong education for all citizens.

Undergraduate education is a particular key in the continuum from kindergarten through graduate education. It provides both the depth and breadth needed for future scientists, but it also should provide proper scientific understanding for those college students who will not be scientists and engineers, but who will be leaders or participants of industry, the professions and government.

NSF's Undergraduate Division, which I am privileged to represent, is located in the Science and Engineering Education Directorate. USEME, as the acronym goes, is a multi-disciplinary group of scientists and engineers devoted to the health and vitality of undergraduate science, mathematics and engineering education in our nation's higher education enterprise. And that is our only goal.

And certainly a fully recognized part of our concern and our goal are the two-year and community colleges. As their name implies, they are there in the community, providing access without parallel.

It is also well understood that they have very high enrollments of minority students who are so critical to our future technical work force, but they are also producing right now, according to Department of Education data that I have just seen, 15 percent of students now receiving baccalaureate degrees in the natural sciences and engineering attended two-year and community colleges. Fifteen percent. Those are significant figures.

Two-year colleges have problems and opportunities that are, in some measure, analogous to those of four-year institutions: faculty,

curriculum and laboratories, for example, but frequently, two-year college faculty do not have the time outside of their teaching duties to develop both themselves professionally and technically in their fields and, consequently, to develop the kinds of proposals and plans that NSF requires in all of its merit-based competitions.

Our instrumentation program is a case in point. This program is of almost universal interest to faculty in—at all types of institutions throughout the country. Last year, we received a total of 2300 proposals, 1000 from universities, 1100 from four-year predominantly undergraduate colleges and universities, but only 177 from two-year colleges. This year, the figures did not change significantly.

We make awards in the college science improvement—the college science instrumentation program each year to several hundred institutions in every nook and cranny in the country from this program, and they are all merit-based.

I agree with Dr. Kraft that we should be more proactive and we have begun to be so. I hope that the extensive USEME staff participation in outreach sessions with the American Association of Community and Junior Colleges and other two-year college groups and our continued involvement of two-year college faculty on our review panels, as well as other interactions, will increase the proposal submission rate to our programs.

It is probably small coincidence that USEME has had significant interactions with at least two of the other two-year college representatives here today.

Looking now specifically at the 1989 program, the NSF fully understands the committee's target of providing $5 million in support for two-year colleges. I expect to have significant results in all of USEME's programs. This includes the college science instrumentation program, the faculty enhancement program that supports faculty development activities, conferences and workshops and short courses, the career access program, whose primary support is for the NSF comprehensive regional centers for minorities, and the curriculum development programs in mathematics and engineering.

There will also be significant support from SEE's pre-college areas as well.

As you know, the majority of NSF support for undergraduate education is spread throughout the research program directorates. In its role of coordinating NSF undergraduate programs, USEME will make available to the research directorates any knowledge and understanding that may accrue from our experience in outreach to the two-year college community.

USEME will also continue to work with the two-year college community to seek ways to leverage our support for best effect. In this regard, last fall, we sponsored a two-year college workshop. This was an outstanding group of two-year college representatives and industry and universities were involved as well.

The report of that workshop, I understand, will be discussed shortly by Dr. Menefee. We will be publishing and distributing that report ourselves widely in the very near future.

And in response to the recommendations of that workshop for the future, NSF is now evaluating a possible program which would support partnerships of two-year colleges with four-year colleges

and universities for strengthening two-year colleges and their interface with upper division institutions.

Typically, this would involve a central university and partnership with a cluster of two-year colleges working on coordinated faculty and curriculum development activities. This could also have a longer-range outcome of helping two-year college faculty to compete in other NSF programs.

I'd be happy to answer any questions you have.

[The prepared statement of Dr. Watson follows:]

TESTIMONY

DR. ROBERT F. WATSON

NATIONAL SCIENCE FOUNDATION

COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY

U. S. HOUSE OF REPRESENTATIVES

WASHINGTON, DC

APRIL 11, 1989

Introduction

Mr. Chairman, it is a pleasure to have the opportunity to discuss with you science and technology education in two-year colleges, and to describe NSF activities in this important area. Much of what I have to say today is taken from the study and report which we submitted to you in January.

I am the Director of NSF's Division of Undergraduate Science, Engineering, and Mathematics Education (USEME), located in the Science and Engineering Education Directorate (SEE). USEME is a new unit created to serve as the Foundation's focal point for support of and leadership in undergraduate education. USEME's role is unusual in that it has 2 distinct charges: Program management for undergraduate activities budgeted within SEE; and also Coordination of the NSF mission in undergraduate education throughout the Foundation. Undergraduate support is provided through all budgetary Activities of the Foundation. Support for 2-year and community colleges naturally falls within the area of the NSF undergraduate effort.

Background

There are over 1300 two-year colleges in the United States--70 percent public and 30 percent private--which enroll 4.7 million students. This represents half of the minorities in higher education and 37 percent of all college students. While these institutions serve a variety of purposes for students, they have a single dominant mission--instruction.

Within two-year colleges, valuable human resources are available if nurtured and provided with stimulating learning in science, mathematics, and engineering. The most notable strengths of two-

year colleges are: a) access to higher education for those who might not otherwise have such opportunities, b) diversity of learning purposes ranging from personal growth courses and remediation to the first two years of college; and c) significant enrollments of minority and low-income students. United States two-year colleges and their students are a major national resource.

These colleges provide courses which will prepare students for college work, and they offer the first two years of college science, mathematics, and engineering. In the future, given changing demographics and the needs of the work force, these institutions have the potential to meet important personnel needs for the fields of science and technology. In particular, they offer an important opportunity to attract significant numbers of minorities into science and engineering.

Problems in science and engineering for two-year colleges are analogous to those of many four-year institutions: keeping faculty up to date in their fields, developing courses and programs of study that attract and retain students--particularly minorities and women, developing the laboratory component of science and engineering courses, and making sure that there is a strong articulation for the precollege experience of science, mathematics, and engineering students. A serious need also is to smooth the interface with four-year institutions for two-year college transfer students.

Limited professional development opportunities, heavy teaching loads, and the lack of scholarly tradition keep many two-year college faculty in isolation from the mainstream of their science, mathematics, or engineering disciplines. Since teaching is the mission of two-year colleges, research is not a faculty responsibility; however, faculty often lack the time and collegial interaction to develop other scholarly pursuits which keep them in tune with events and discoveries in their scientific or engineering fields of teaching.

Thus there is little experience or tradition with the development of proposals at two-year colleges such as NSF requires in its merit-based review processes. This is not surprising given their mission. However, it does follow that even in NSF programs suited to the interests and needs of two-year college faculty, they frequently do not submit proposals in numbers that can produce a major impact in the awards.

In response to this essentially cultural context, the USEME staff are aware of and sensitive to the particularly difficult situation faced by two-year college faculty with regard to NSF programming; and we have been working extensively with the American Association of Community and Junior Colleges (AACJC) and other community college groups in various kinds of outreach

activities with the goal of better acquainting faculty with available NSF science education programs. These efforts have improved our understanding of two-year colleges and given us a better basis on which to work with faculty and administrators in two-year colleges as we develop programs to improve the quality of their programs in science, engineering, and mathematics.

This activity, however, can not alter some of the fundamental hurdles two-year college faculty have in developing and submitting their own proposals. It is for this reason that in addition to continuing this effort, the NSF Long Range Plan contains a major proposal for assisting two-year colleges that centers on partnerships with neighboring four-year colleges and universities.

The National Science Foundation - A Targeted Role

The appropriate role for the National Science Foundation is one of intellectual and substantive leadership. The Foundation is able to draw upon its position in the science and engineering communities to provide leadership, developmental support, and intellectual resources to strengthen two-year college science and engineering.

The Foundation's leadership will be most effective in making sure that the quality of funded programs is consistent with sound scientific and engineering principles. The Foundation is in a particularly strong position to leverage its resources through its undergraduate programs and planned innovative initiatives which increase the collaboration among two- and four-year colleges.

The Foundation is best able to focus on three areas which affect all parts of the instructional programs in science and engineering -- faculty, curriculum, and laboratories. Programmatically, the Foundation includes two-year colleges as eligible participants in four areas: 1) faculty enhancement in the content areas of science, mathematics, and engineering, 2) curriculum and instructional improvement, 3) the development of laboratory components of science and engineering programs, and 4) collaborations - a) to improve articulation between two-year college and secondary school science and mathematics programs, and b) to improve cooperation and articulation between two- and four-year institutions of higher education.

Two-year colleges are technically eligible to receive support directly and possibly to benefit in other ways from essentially all NSF programming areas. However, as most NSF funds are in support of basic research, whereas the mission of the institutions is purely instructional, it is true that they receive a relatively small fraction of the total NSF budget. This amount is increasing. Two-year colleges are participating

in an increasingly significant way in SEE's science and engineering education programs, which are relevant to their needs, missions, and interests.

At present, the focus for most of this support is the USEME Division. For example, you may recall that the College Science Instrumentation Program (CSIP) eligibility was extended to two-year colleges beginning in FY 1988. That first year of eligibility yielded 39 two-year college awards totalling $ 1.2 million at a proposal success rate comparable to that of all institutions (22% vs. 28%). However, it is worth noting that two-year colleges submitted only 177 proposals; whereas four-year colleges submitted 1,119.

Projects at and for the benefit of two-year colleges have also been supported in other USEME programs, in the SEE precollege improvement programs, and to a limited degree in the research directorates. Some examples follow:

o Undergraduate Faculty Enhancement Program

The Mathematics Association of Two-Year Colleges of New Jersey, through Union County Community College, conducted a workshop on applications of discrete mathematics. This included weekend lectures and small group projects during the summer. Applications to fields such as genetics, engineering, and computer science are covered.

Western Washington University conducted summer workshops in Modes of Programming for community college instructors. Topics include Expert Systems Programming, Fourth Generation Language Programming, Graphics Programming and Object Oriented Programming. (Note: This project was for the benefit of two-year college faculty, although the NSF grantee is a university).

o College Science Instrumentation

Students at Midlands Technical College, a two-year college in Columbia, South Carolina, study process control in a state-of-the-art training laboratory. This laboratory, equipped with programmable logic controllers, permits students to apply their understanding of classical control theory within an integrated technological setting.

A grant to Bee County Community College in Beeville, Texas, allows Professor Michael Griffin to enhance instruction of students (largely Hispanic women) in how to prepare bacteriological cultures. The new equipment will significantly improve the efficiency and safety of the microbiology laboratory.

- **Undergraduate Mathematics Curriculum Development Program**

Students at the Community College of Philadelphia (PA) are participating in a project devoted to presenting the key ideas of calculus using the concept of approximating functions with polynomials. This is a departure from the traditional way of approaching these ideas using the concept of limit.

- **Young Scholars Program**

A grant to Mountain Empire Community College in Big Stone Gap, Virginia, supported a four-week summer enrichment project for high school students that focused on environmental and ecological problems. Activities included classroom instruction, hands-on investigations, and work in the field. The project was a part of the Governor's School Program.

- **Engineering Research Centers Program**

A planning grant was awarded to The Williamsport Area Community College (PA) to support a Technology Transfer Center, which will address the training needs of industries wishing to implement Computer Integrated Manufacturing (CIM) Technologies. This NSF grant enables Williamsport Community College, in conjunction with Purdue and Ohio State ERCs and Pennsylvania State University, to experiment in determining a role for community colleges in technology transfer to regional manufacturers.

FY 1989 Status and Plans

For FY 1989, the NSF fully understands the Committee's target of providing $5 million in support for two-year colleges and is well on the way to achieving it. We expect to have significant support and benefit in the programs referred to above and also in programs such as USEME's Career Access (NSF Minority Centers), and in the precollege area, Teacher Preparation, and Teacher Enhancement.

As you know the majority of FY 1989 and planned FY 1990 NSF undergraduate program support is distributed throughout the research program support directorates. In its role of coordinating NSF undergraduate programs, USEME will make available to the research directorates any knowledge and understanding that may accrue from its experience in outreach to the two-year college community.

On a longer range basis, NSF is currently evaluating a program of institutional challenge grants to colleges, universities, and consortia for strengthening two-year colleges and the interface between two- and four-year colleges and universities. Typically, this will involve a central university in partnership with a cluster of two-year colleges working on coordinated faculty and

curriculum development activities focusing on lower division instruction in mathematics, the sciences, and engineering. (The NSF Science and Engineering Education Strategic Plan FY 1989-93, January 1989, p. 22.)

These activities and programs are based on a systematic approach to analysis of the nature, goals, and needs of two-year colleges. NSF's current undergraduate program has much of its impetus from the NSB Task Committee on Undergraduate Science and Engineering Education Report published in 1986. There was significant input to that study from the American Association of Community and Junior Colleges.

The NSB Report contains the following statement: "The two-year colleges are part of higher education. Their transfer programs provide large numbers of upper division students to four-year institutions. Articulation of this transfer point is difficult and requires serious and permanent collaborative efforts between the source and acceptor colleges."

Comments on Advanced Technician Training Act

The Chairman should be commended on his concern for the quality of instruction in two-year colleges, and more broadly for the productivity of the Nation's industries and the competitiveness of the United States in international trade. We share these concerns and concur that the goals described in the bill are indeed worthy.

The NSF plan for strengthening undergraduate education in science, engineering, and mathematics education in the two-year colleges as described above, and in more detail in the previously submitted planning documents, takes a broad view of the NSF role with regard to two-year colleges analogous to its role in other undergraduate education at all institutions. It encompasses all of the basic science and engineering courses offered at two-year colleges, not just those in technician training programs. Via the partnerships with four-year colleges and universities, the NSF plan also works toward a higher quality, more vital faculty and curricula.

It is our feeling that NSF should place its effort on helping the two-year colleges strengthen the foundations of their basic science, mathematics, and engineering programs. This will serve to benefit in the broadest and most fundamental way the colleges and their full population of students, not just those concentrated in technician training programs.

The NSF has problems within this legislation, not because of its intent, but because of this fiscally constrained environment support for narrowly targeted efforts may indeed come at the expense of much broader and equally meritorious programs

addressing the needs of two-year colleges. The NSF clearly has the legislative charter to address the needs outlined in the proposed bill. Thus, we would prefer to work with you directly, without the restrictive nature of this legislation, to ensure that our programs are responsive to your proposal.

The Office of Management and Budget has advised that there is no objection to the submission of this report from the standpoint of the Administration's program.

Mr. WALGREN. Thank you, Dr. Watson, appreciate that.

Dr. Chubin.

Dr. CHUBIN. Thank you, Mr. Chairman.

As you know, the Office of Technology Assessment, at the request of this committee, conducted a study on human resources for science and engineering. That study resulted in a policy report, "Educating Scientists and Engineers, Grade School to Grad School," issued last June.

Two supporting documents, "Elementary and Secondary Education for Science and Engineering," and "Higher Education for Science and Engineering," were published in December of 1988 and March 1989, respectively.

OTA has tried to develop the big picture of science education in the United States. I would like to share some of that picture today.

Science and engineering education is best seen as part of all one system that extends from the elementary grades through graduate study, but all one system also refers to diverse educational environments in school and out. No one environment is suitable for all students. Each environment plays a distinctive role in contributing trained personnel to the future science and engineering work force.

Large research universities, small liberal arts colleges, historically black institutions, traditionally women's colleges, four-year comprehensive institutions and two-year and community colleges, all award degrees. Ideally, each institutional category supports and interacts with the others.

In an age of increasing specialization, students require education and training certified in two ways: by conferral of a degree and by movement from one stage of the system to the next, from one degree to the next.

A key word is transition, transferring students from one educational environment to another. It appears that the transfer function is not being well-served by the participating institutions. They do not see themselves as part of all one system. An important policy question, then, is how to improve the transfer function.

Historically, community colleges have played two major roles related to science and engineering: technician training and continuing education. These schools, OTA found, provide an alternative route into the science and engineering pipeline by preparing students for entry to baccalaureate-granting colleges. Transfer of community college students into engineering at baccalaureate-granting institutions, for example, almost compensates for attrition of freshmen and sophomores at those latter institutions.

The opportunity to transfer is particularly significant for minorities as blacks and Hispanics who continue their education beyond high school are much more likely than whites to enter community colleges. The high proportion of minority students who begin their collegiate experience at community colleges and the dearth of minorities in science and engineering makes the transfer function critical.

However, from a national perspective, community colleges are not moving blacks and Hispanics toward four-year degrees. They are much less likely to transfer out of community colleges than are whites.

A second policy question, then, is how to help make community colleges a fertile educational environment for minorities, whether they seek associate degrees or advanced degrees. States with large minority populations, such as California and Florida, have established student assessment and placement programs, in cooperation with four-year institutions, to prepare those who wish to transfer.

In the near term, the concentration of minority students suggests that a few targeted and well-supported programs could make a difference. One opportunity for Federal action could be the formal linkage of pre-college school- and community-based programs to two- and four-year institutions. Summer programs such as the Department of Energy's PREP awards, Pre-freshman Engineering Program, show junior high school students the connections between college attendance and degrees. It is a compelling form of career counseling.

Just as students must perceive employment opportunities, the institutions that train them must function as part of a stream of career preparation. Enrollment and course-taking are not ends in themselves.

To this end, another mechanism for coupling engineering education to work force participation is cooperative education, or CO-OP. In the mid-1970s, the Federal Government, through Title 8 of the Higher Education Act, funded colleges that established co-op links with business and industry. Through co-op education, students tends to receive not only the benefit of hands-on experience, role models and career guidance, but also higher salaries and better jobs once they graduate.

It may be time for the Federal Government to revisit cooperative education and, within it, especially the role of the two-year college. A growing national concern is the supply of well-trained engineering technicians. The Engineering Manpower Commission, EMC, reports that about 12,000 four-year baccalaureate degrees and 14,000 two-year associate degrees were awarded in engineering technology in 1987.

Data on the definition accreditation and the quality of many of these two-year pre-engineering and so-called three-plus-two transfer programs offered by four-year institutions are illusive, however.

The policy lesson is this: Engineering technology and technician students and institutions have historically been outside the mainstream of U.S. science and engineering education. Though a source of engineering talent through mobility and training, they are often ignored in R&D policy. NSF, with its principal focus on universities, research and Ph.D.s, has not been involved in technician training.

Universities employ technicians in science and engineering, but there is no national recruitment pattern for these members of the technical work force. Directing NSF to designate centers of excellence at community colleges to serve as clearinghouses and model training programs, as stated in the 1987 version of the National Technician Training Act, might begin to remedy this situation.

It is not clear, however, that NSF is the only or most appropriate agency to designate and oversee such centers. More generally, better coordination of course content and degree requirements between two- and four-year institutions could make it more likely

that academically oriented technician or technology students would be able to transfer to engineering programs.

This was recently recommended by the Engineering Dean's Council of the American Society for Engineering Education. It is consistent with OTA's finding that the pipeline can be made more welcoming to more students, without accentuating the quality of future scientists and engineers.

Clearly, the institutions where students are enrolling, two-year institutions and four-year comprehensive colleges, have a large potential contribution to make to science and engineering education. How large? We do not know.

Like every other category of institution, two-year colleges cannct do it alone. Facilitating the passage of two-year and community college graduates into four-year institutions would be in keeping with the traditional Federal role.

Thank you.

[The prepared statement of Dr. Chubin follows:]

STATEMENT OF DR. DARYL E. CHUBIN
Project Director
Office of Technology Assessment
U.S. Congress

Testimony Before the
Subcommittee on Science, Research, and Technology
House Committee on Science, Space, and Technology

EDUCATING SCIENTISTS AND ENGINEERS: ROLES OF TWO-YEAR COLLEGES

April 11, 1989

EDUCATING SCIENTISTS AND ENGINEERS: ROLES OF TWO-YEAR COLLEGES

Statement of Dr. Daryl E. Chubin
Project Director
Office of Technology Assessment
U.S. Congress

Good afternoon! As you know, Mr. Chairman, the Office of Technology Assessment, at the request of this Committee, conducted a study on human resources for science and engineering. That study resulted in a policy report, Educating Scientists and Engineers: Grade School to Grad School, issued last June. Two supporting documents, Elementary and Secondary Education for Science and Engineering and Higher Education for Science and Engineering, were published in December 1988 and March 1989, respectively. During the course of the OTA assessment, we learned much about the "big picture" of science education in the United States.

Using our most recent report as a palette, I would like to paint some of that picture and what it suggests about the Federal role in helping to sustain institutions of higher education in their preparation of students for careers in science and engineering.

The "All One System" Approach

Science and engineering education is best seen as a part of "all one system," that extends from the elementary grades through graduate study. But "all one system" also refers to diverse educational environments, in school and out, as well as familiar categories of colleges and universities.

Various factors draw students to science and engineering majors; other factors can influence whether or not they reach their goal (see Attachment 1, table 2-1). No one environment is suitable for all students. Each environment plays a distinctive role in contributing trained personnel to the future science and engineering work force.

Large research universities, small liberal arts colleges, historically Black institutions, traditionally women's colleges, 4-year comprehensive institutions, and 2-year and community colleges all produce new degree recipients. Each institutional category supports and interacts with the others, for none exists in a vacuum. In an age of increasing specialization, students require education and training certified in two ways: by conferral of a terminal degree, and by movement from one stage of the system to the next, from one degree to the next.

A key word is transition: transferring students from one educational environment to another. The ingredients are student aspiration and preparation on the one hand, institutional cooperation and commitment on the other. It appears that the transfer function is not being well-served by the participating institutions. They do not see themselves as part of "all one system." An important policy question, then, is how to improve the transfer function.

Community Colleges: An Alternate Entry Route to Science and Engineering?

Historically, community colleges have played two major roles related to science and engineering: technician training and continuing education. Almost 1,300 U.S. community colleges enroll over one-half of first-time freshmen -- 2 million in 1985. These schools, OTA found, fill several niches in science and engineering education. First, they provide an alternate entry route into the science and engineering pipeline by preparing students for entry to B.S.-granting colleges. Second, and currently most vital to the Nation's research and development (R&D) effort, they train technicians and technologists. Third, a growing part of community college service is customized training, primarily for industry. (Another, smaller role of community colleges is offering courses, unavailable elsewhere, to high school students.)

Five to 15 percent of all community college students transfer to 4-year institutions. About 40 percent of community college graduates enter these institutions. Transfer of community college students into engineering at baccalaureate-granting institutions, for example, almost compensates for attrition of freshmen and sophomores at those latter institutions.

The opportunity to transfer is particularly significant for minorities, as Blacks and Hispanics who continue their education beyond high school are much more likely than whites to enter community colleges. The high proportion of minority students (over half) who begin their collegiate experience at community colleges -- and the dearth of minorities in science and engineering -- makes the transfer function critical. However, from a national perspective, community colleges are not moving Blacks and Hispanics toward 4-year degrees; they are much less likely to transfer out of community colleges than are whites.

A second policy question is how to help make community colleges a fertile educational environment for minorities -- whether they seek terminal associate degrees or advanced degrees. States with large minority populations, such as California and Florida, have established student assessment and placement programs in cooperation with 4-year institutions to prepare those who wish to transfer. Attachment 2 (box 2-B) describes one college-based intervention, the Minority Engineering Program (MEP), that now operates on every campus of the California State

University system. From the perspective of institutions that receive minority talent, including some from 2-year colleges, the MEP is impressive in its rates of retention to the baccalaureate, especially in contrast to national retention rates of engineering students (see Attachment 3, figure 4-7).

An Historic Role for the Federal Government: Engineering Education

OTA found that the size of the engineering talent pool is set early in the educational process, more so perhaps than in other majors. Most freshman engineering majors choose this field by the 11th grade. A hierarchical and sequential college-preparatory curriculum -- the "academic track" -- is designed for the early-committed student. Once in college, it is difficult to enter engineering from other majors.

Although mathematics and science are taught in high school as "foundation" courses for technical careers, there are very few "pre-engineering" programs; these tend to be vocationally-oriented. Most are targeted to minorities or the gifted and talented. (Well-known examples include PRIME -- the Philadelphia Regional Introduction for Minorities to Engineering; MITE -- the Minority Introduction to Engineering Program, a creation of the Junior Engineering Technology Society; and NACME -- the National Action Council for Minorities in Education. Cost-sharing with industry and private foundations is common.)

Ten institutions produce one-third of today's Black baccalaureate engineers; 21 institutions produce 60 percent of Hispanic engineers. In the near term, this concentration of minority students suggests that a few targeted and well-supported programs could make a difference. One opportunity for Federal action could be the formal linkage of precollege school- and community-based programs to 2- and 4-year institutions. Summer programs such as the Department of Energy's PREP awards -- Prefreshman Engineering Program -- show junior high school students the connections between college attendance and degrees; it is a compelling form of career counseling.

Just as students must perceive employment possibilities, the institutions that train them must function as part of a stream of career preparation; enrollment and course-taking are <u>not</u> ends in themselves. To this end, another mechanism for coupling engineering education to work force participation, dating to early in the 20th century, is cooperative education or "co-op." In the mid-1970s, the Federal Government, through amendment (Title VIII) of the Higher Education Act of 1965, funded colleges that established co-op links with business and industry (see Attachment 4, figure 4-10). Through co-op education, OTA learned, graduates tend to receive not only the benefit of hands-on experience, role models, and career guidance while students, but also higher salaries and better jobs. It may be time for the Federal Government to revisit cooperative education, and within it especially the role of the 2-year college.

A growing national concern is the supply of well-trained engineering technicians, qualified minimally at the 2-year associate level, and the capacity of institutions to train more. The Engineering Manpower Commission (EMC) reports that about 12,000 4-year baccalaureate degrees and 14,000 2-year associate degrees were awarded in engineering technology in 1987. Data on the definition, accreditation, and therefore the quality of many of these 2-year (pre-engineering) and "3+2" transfer programs offered by 4-year institutions, however, are elusive. (EMC surveyed 291 institutions offering engineering technology degrees in 1987 and accredited by ABET, the Accreditation Board for Engineering and Technology. EMC estimates that there are hundreds of additional unaccredited programs enrolling students today.)

Investing in Talent for the Nation's Work Force

The policy lesson is this. Engineering technology and technician students and institutions have historically been outside the mainstream of U.S. science and engineering education. Though a source of engineering talent through mobility and training, they are often ignored in R&D policy. NSF, with its principal focus on universities, research, and Ph.D.s, has not been involved in technician training. Universities employ technicians in science and engineering, but there is no national recruitment pattern for these members of the technical work force. Directing NSF to designate centers of excellence at community colleges to serve as clearinghouses and model training programs, as stated in the

proposed 1987 National Technical Training Act (H.R. 2134), might begin to remedy this situation. It is not clear, however, that NSF is the only, or most appropriate, agency to designate and oversee such centers.

More generally, better coordination of course content and degree requirements between 2- and 4-year institutions could make it more likely that academically-oriented technician or technology students would be able to transfer to engineering programs. This was recently recommended by the Engineering Dean's Council of the American Society for Engineering Education (see Attachment 5, box 4-B). It is consistent with OTA's finding that the so-called pipeline can be made more welcoming to more students, without attenuating the quality of future scientists and engineers. This seems a reasonable expectation, given the division of labor among U.S. institutions of higher education.

There is nothing in the American educational system comparable to institutions created in England, France, and Germany in the 19th century to provide mobility into engineering jobs for skilled workers lacking formal education. The tension between the shop culture of early American engineering and the university culture of post-World War II science-based engineering has widened the gulf between engineers with degrees and skilled workers without them. Skilled workers possess valuable expertise, but without a formal credential or professional license they are not considered "engineers."

Clearly, the institutions where students are enrolling -- 2-year and 4-year comprehensive colleges -- have a large potential contribution to make to science and engineering education. How large? We do not know. Like every other category of institution, 2-year colleges can not do it alone. Facilitating the passage of 2-year and community-college graduates into 4-year institutions where the baccalaureate can be achieved is in the mainstream of the traditional Federal role: providing financial support to ensure individuals educational opportunity, and assisting colleges and universities to fulfill their respective missions of producing high-quality and versatile new entrants to the U.S. work force.

Attachment 1

Table 2-1.-Factors Affecting Undergraduates' Choice of a Science or Engineering Major

Most students have decided on a major by the time they enter college. Innate interest, school experiences, and teacher influences play a large role. Demographic factors, particularly socioeconomic advantages, parents' backgrounds, and education and career values associated with certain ethnic groups, confer preferences that are difficult to affect through policy. However, there is substantial readjustment during the college years, as students tackle college-level courses, encounter new subjects, and face the prospect of earning a living. Many students leave science or engineering altogether; some shift among the sciences; and a few enter from nontechnical majors. Various factors during the college years encourage students to enter or stay in science or engineering.

Factors that attract students:

- Job market for scientists and engineers
- Academic preparation and achievement in high school (particularly including coursework in mathematics; science and computer coursework are also important)

Factors that reduce attrition (and improve the chances of college graduation in any field, not just in science or engineering):

- University attention to student completion ("institutional nurturing")
- Intervention programs and peer support
- Research participation
- Good teaching
- Financial support
- Part-time work or cooperative study

SOURCE: U.S. Congress, Office of Technology Assessment, Higher Education for Science and Engineering--A Background Paper, OTA-BP-SET-52 (Washington, DC: U.S. Government Printing Office, March 1989).

Attachment 2

Box 2-B. — Retaining Hispanics and Blacks in Engineering: California's Minority Engineering Program

The California Minority Engineering Program (MEP) has dramatically improved the retention of Black and Hispanic students in engineering majors in California public universities and colleges.[1] Not only are MEP students much more likely to stay with engineering than are minorities students not in MEP, but they even outperform majority engineering students (see table below). MEP began at one institution in 1973. In 1982, the State funded the expansion of MEP to most other California university campuses. In 1986-87, about 2,500 students were in MEP.

Crucial elements of MEP — and crucial to most intervention programs — are:

- peer support, tutoring, and community building among minority students;
- academic support through science and mathematics workshops; and
- professional and personal support through participation in student organizations, summer jobs, internships, and career awareness activities.

The founder of MEP, Raymond B. Landis, emphasizes the particular importance of helping students through the freshman year, usually the most difficult phase of academic and social adjustment for minorities. His relatively low-cost programs includes in-depth, formal university and academic orientation, clustering MEP students in the same classes so they can work together on the same assignments, upper-class mentors, and a 24-hour student study center. Regular classes are supplemented with both prefreshmen bridge programs and workshops. MEP also facilitates employment and career development through summer jobs, internships, and career presentations.

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1. California Postsecondary Education Commission, "Retention of Students in Engineering: A Report to the Legislature in Response to Senate Concurrent Resolution 16 (1985)," unpublished draft, December 15, 1986; Raymond B. Landis, "The Case for Minority Engineering Programs," *Engineering Education*, vol. 78, No. 8, May 1988, pp. 756-761; and Cheryl M. Fields, "What Works: California's Minority Engineering Program," *The Chronicle of Higher Education*, Sept. 30, 1987, p. A33. See also National Action Council for Minorities in Engineering, *Improving the Retention and Graduation of Minorities in Engineering* (New York, NY: 1985).

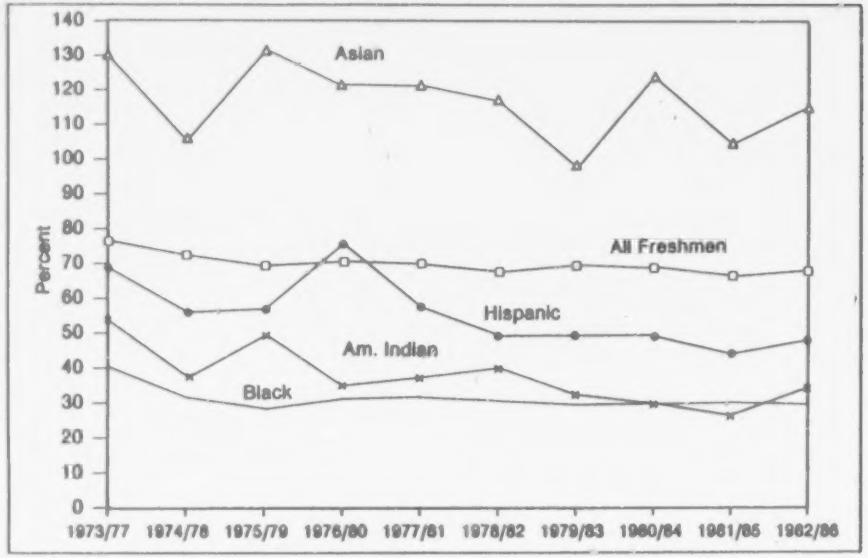
In 1984-85, 19 California public institutions enrolled over 31,000 engineering undergraduates and awarded 5,391 engineering baccalaureates, about 7 percent of national enrollments and degree awards.

Attachment 2 (cont'd.)

Three-Year Retention Rates of Fall 1982 Engineering Freshmen, Students in and Not in the Minority Engineering Program (MEP) (as percent of entering freshmen)

	All Students	Blacks in MEP	Blacks not in MEP	Hispanics in MEP	Hispanics not in MEP
University of California	47	64	23	57	21
California State University	67	79	30	88	41

Figure 4-7.-Retention Rates of Engineering Freshmen, 1973/77-1982/86

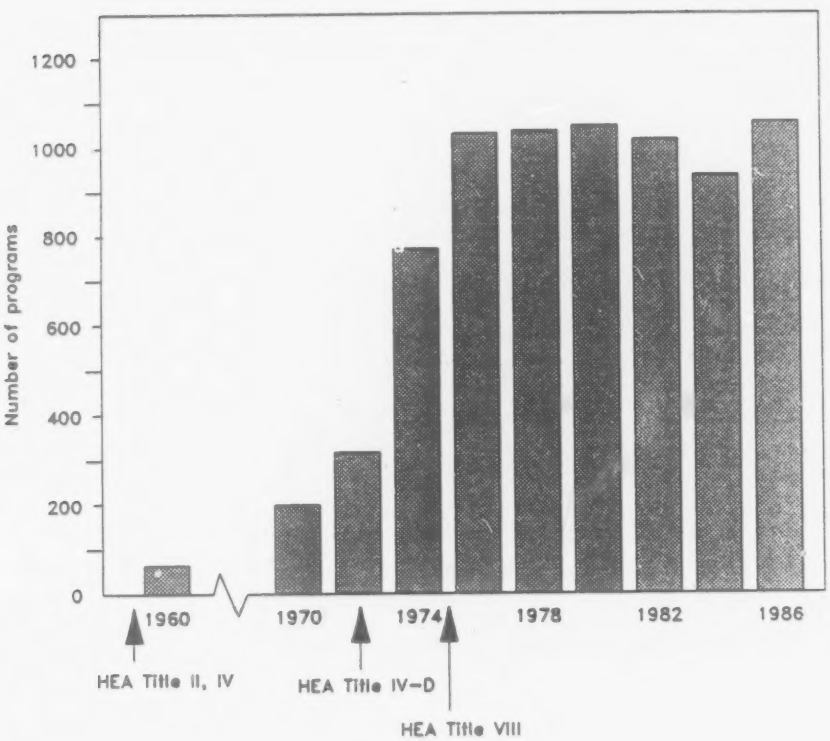


NOTE: Asian student retention rates greater than 100% reflect the fact that the drop-out rate among freshmen and sophmores is less than the input at the junior year from two-year institutions.

SOURCE: Betty M. Vetter, "Demographics of the Engineering Student Pipeline," Engineering Education, vol. 78, No. 8, May 1988, p. 739.

Attachment 4

Figure 4-10.-Cooperative Education Programs, 1960-86



NOTES: Includes Canada (less than 5% of total programs).
In 1986, 1,016 U.S. programs enrolled 198,000 students.
Includes junior college programs, which account for about 40% of the total of both programs and students.
About 30% of cooperative education students are in engineering.

SOURCE: Cooperative Education Research Center, "Cooperative Education in the United States and Canada" (Boston, MA: Northeastern University, January 1987); and James W. Wilson, "Cooperative Education-A National Assessment" (Boston, MA: Cooperative Education Research Center, Northeastern University, April 1988).

Attachment 5

Box 4-B. — Expanding the Engineering Pool: Recommendations of the Engineering Deans Council

To attract more able students, to provide a more supportive environment, and to make engineering education more accessible, engineering educators should:[1]

Improve undergraduate recruitment and retention, especially of women and minorities

- Support and publicize intervention programs tailored for women and minorities through institutional consortia.
- Improve guidance materials.
- Strengthen elementary and secondary mathematics and science education.
- Coordinate curricula and counseling with community colleges to increase transfer to 4-year colleges, especially for women and minorities.
- Encourage dual-degree and transfer programs with liberal arts colleges.
- Keep better data on educational and career paths, especially retention rates.
- Implement lessons from successful intervention programs which improve the academic performance and retention of engineering undergraduates, especially women and minorities. In particular, support:
  - extended programs which allow students to proceed at a slower pace;
  - ambience that encourages nurturing, not weeding out;
  - orientation and transition programs for entering freshmen;
  - engineering student organizations; and
  - effective academic advising.
- Ensure that faculty are sensitive to the special needs of women and minorities.
- Establish specific goals, such as doubling the number of women enrolled by the end of the decade.

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1. Based on Report of the Task Force on the Engineering Student Pipeline, "Findings & Recommendations," *Engineering Education*, vol. 78, May 1988, pp. 778-780.

- Support programs to help women re-enter engineering after career interruptions.

Increase graduate enrollments

- Establish recruitment and retention goals for minority students.
- Sharpen recruiting of U.S. engineering graduate students, by:
  - actively targeting and recruiting promising undergraduates;
  - encouraging undergraduates to do research;
  - developing ties between graduate schools and undergraduate institutions with large minority enrollments;
  - opening engineering graduate study to nonengineering undergraduates;
  - publishing a guide to graduate programs; and
  - creating a listing in which graduate students and schools can find each other.
- Adjust graduate student stipends to at least one-half the starting salary for a B.S. engineer.
- Double the number of graduate fellowships available.
- Restore the tax deductibility of both tuition remission and graduate student stipends.

Mr. WALGREN. Thank you, Dr. Chubin.

Well, I appreciate that testimony and I can emphasize—empathize with the feeling that perhaps there are other agencies as well that have this responsibility, but I think it's pretty clear that there is such an unmet need there that somebody has got to show the way and—and we have to get started on it if we're to succeed as an enterprise, as a nation.

And it troubles me a great deal how it—the NSF, with such basic educational responsibilities that they have taken on very broadly all the way down to the first grade, has been so undeveloped in this area. I'd—I wish I knew the reasons why.

I came from a hearing this morning in which a demographer was saying that—that—that if we were to increase the productivity of the society to the degree that the increasing burdens of aging and particularly health costs, but also education, would not be overwhelming, that what we needed was research and—and new methods of providing services, rather than new methods of providing manufactured products.

And it was a new idea to me, but one that seemed to me to be interesting and worth trying to pursue. And—and I would—I think of education as a service, essentially, although that witness was going on and saying particularly in health care, how important it was to do research in making the provision of the service more efficient and, therefore, increasing productivity.

I guess my question, Dr. Watson, is do we see some role for the NSF in doing that kind of research on the provision of services, as opposed to research into the nature of matter or nature itself?

Dr. WATSON. The—in terms of research support, I think probably the closest that we would—that NSF has would be in the social sciences, basic research in the social sciences. The sorts of support that at least normally think of in terms of two-year colleges and four-year colleges and so forth is assistance with the development of their undergraduate teaching laboratories, development of curricula, the basic science curricula of those institutions.

Mr. WALGREN. But we can't point to too much participation in the curricula development at this point, can we?

Dr. WATSON. No. No. That's an activity that we've only just begun and, at the present time, of course, we're only supporting mathematics and engineering. And we have not had much at all response from the two-year college community in undergraduate curriculum.

Mr. WALGREN. In terms of proposals submitted to you, the—I suppose there is a chicken-and-egg phenomenon there. I mean, I know that you're—that we could sit back and say, "Well, we're just going to wait until they come in," but NSF shows every interest in other areas of anticipating what problems might be and I—I—just the fact that they have been not involved in developing curricula, which is one of the first things that you would do and things that you do traditionally in other areas. You develop it for the first grade, second grade, third grade; you develop it for—for certainly undergraduate and high schools, and yet nothing in the two-year college area.

I—I just really don't know that—that that's going to solve our problem, if we just sit and say, "Well, they haven't come in yet."

Dr. WATSON. I—I certainly agree with you on that. I—we have, in the Undergraduate Division, devoted a significant, I think, fraction, given the total level of our resources, to working with two-year college groups around the country. Last week, one of the Undergraduate Division staff coincidentally happened to be at a meeting with—that Dr. Clevenger organized and next week, another member of our staff will be going to another meeting to—to discuss our programs with two-year colleges.

I think there are—there are a couple of hurdles that are extraordinary, somewhat, with the two-year college faculty. The overall teaching loads—the responsibilities for two-year college faculty are in the instructional and teaching delivery, and so there isn't a tradition of interacting with NSF the way there is on the part of a lot of other kinds of institutions.

So I think we can—we can do some things in that regard by these kinds of outreach sorts of activities, but that won't basically change the—nor should it, perhaps—change the roles and responsibilities of two-year college faculty. That's why I think one of the outcomes from this workshop that we had that involved quite a number of leading people from various two-year colleges and other roles around the country, a primary recommendation was this sort of partnership activity that I mentioned earlier, where two-year colleges and four-year colleges and universities would work together to develop their curricula, and I think, in particular, this would help to develop faculty expertise amongst the two-year college faculty by having formal kinds of interactions with university faculty.

And hopefully, and I believe—I believe probably this would ultimately result in two-year college faculty submitting more and more competitive proposals to us.

Mr. WALGREN. I guess I instinctively can't help but be struck by the fact that the resources that you're prepared to put against the problem are disproportionate to the problem. But I think we have to accept that.

And I'm not so sure that there's any reason to expect the faculty to be doing the kinds of things that the undergraduate faculties are doing to try to make a name for themselves or support themselves or whatever they're doing. My guess is, if I were an undergraduate faculty member, I'd be doing things to put feathers in my own cap within my institution that are not available to teachers in a two-year community college setting. Many of the teachers in two-year community college settings are not focused on—on—on the—the peer standing that researchers who want to—to be seen as prominent in their field are. Oftentimes, they're employed in other avenues, as well as teaching at two-year and community colleges. And so there's no real reason to believe that they would fit in the same mode.

I guess what troubles me is the lack of—of—of the development of a model of what it ought to be, and it would seem to me that that's—that that's the first thing anybody would do. The first thing an industry does is it develops a prototype or it develops a demonstration model and yet, in this area, nothing.

And instead, the testimony was that the—the two-year and community colleges are sort of developing their own curriculum on a local level without any national coordinated mechanism whatso-

ever, trying to—to—to meet the near-term needs that are pressed on them, but without any ability to really look over the national interest as a whole, other than what they're—what the interest of their own little unemployed person knocking at the door and trying to get service might be.

And I'm just really stunned by the fact that—that—that the agency that has taken such initiative and such broad responsibility for educational strength has this gaping hole when it comes to—to two-year and community colleges, and particularly when—when our great lament is—is that women and minorities are not participating, and supposedly, on a demographic basis, we're going to need them and there aren't enough white males to go around and the only place that large numbers of women and minorities are that are at all serious about education is in two-year and community colleges and still, no model, no demonstration, no involvement to show what could happen to—to—to these students. I just plain don't understand it.

Dr. WATSON. I do believe that the curriculum development activities that NSF is currently contemplating and has as part of its long-range plan would be responsive to the concern that you've just—

Mr. WALGREN. Hopefully that's true, but even there, at this point, we have nothing to show for it, and if anything, there aren't very many areas that I can feel that the Congress led the NSF into. The NSF oftentimes has gone out of its way to look for what the constructive action might be and to start to take it and encourage it to happen, and yet, we come up to this area and exactly the reverse is the—is the case.

There's been nothing from NSF, absent now these plans that are yet to come.

The—does NSF have any plans to try to reach women and minorities through community colleges?

Dr. WATSON. The—the—the Minority Centers program, which was begun this past year, expects to have an active two-year college component in it. These projects are aimed at taking a sort of systems approach to minority education, beginning with kindergarten and going all the way through the baccalaureate degree.

And, for example, we made, last year, three new centers awards. The first of the three, one to the area of Puerto Rico, one in Atlanta and one in New York City. There are also some starter kinds of projects begun in Norfolk, Philadelphia, St. Louis and Los Angeles. And those, we expect to have—and will require, as a matter of fact, the involvement of all elements of local education, which certainly will include two-year colleges.

Mr. WALGREN. Well, I sure wish we could see some real strategy that would try to develop those resources. We used to have the women and the minorities program in NSF and that—as I remember, being disbanded a number of years ago, and supposedly the responsibilities for that picked up across the board, but—but the NSF is simply not in a position to train enough or reach enough actual individuals in training to really make any progress on that except through their education function.

And if the education function doesn't—doesn't focus on that in a—in an effective way—and I don't see how you do it if you leave

out the two-year and community colleges—you don't help with the problem at all.

The—I can see the participation and the instrumentation coming up and I think you can—you can look at those numbers and say that you're trying to meet some needs there, but at the same time, we all know that that's sort of the last need that we're going to be able to effectively meet in terms of measuring it against the whole of the need.

And—and although I guess it's helpful to see that, I don't take a lot of comfort out of the fact that NSF is now supporting some instrumentation programs with some percentage of success in application, compared to others, because we've never had enough money to—to do much in that area for anybody.

And until you talk about curriculum and effective development of curriculum, I don't think you're going to make much of a contribution.

Well, let me think—you know, let's think about this two-year, four-year business where Dr. Chubin says that there's a sort of proximity relationship that brings in students from the two-year colleges if you have a coordinated curriculum. That, I gather, is what's being suggested now?

Dr. WATSON. Certainly, I think one of the serious problems that needs attention is the relationship between the two-year—the interface between the two-year college and the upper courses—or upper division courses at the universities.

As I mentioned earlier, we already see that two-year colleges are producing a significant fraction of the—of the graduating students from the baccalaureate programs in the natural sciences and engineerings. Fifteen percent of the total is not a trivial figure, I think.

So making sure that the transition between the two-year college and the university upper-level courses, I think, is a very important part of that partnership kinds of activity between the two- and four-year institutions I mentioned.

That's not the only one. I think it's important to make sure that the—the interface between the high schools and the first two years of college are very important as well.

In fact, in some other workshops that we've had in undergraduate education across the board, there was pretty general agreement, discipline by discipline, that the most serious problems are—at all institutions, two-year, four-year and universities—are at the lower division level, at the freshman and sophomore level. This is where the physicists and the chemists and the mathematicians and the biologists and so forth independently pointed as being the area of greatest need of attention.

So in the curriculum development area, I feel we should put the greatest emphasis—not—certainly not the exclusive emphasis, but the greatest emphasis on the first two years which, of course, are where the two-year colleges focus exclusively.

Mr. WALGREN. Can we see that happening at all?

Dr. WATSON. We've made a start and I would—I would be incorrect if I said it was more than a start, but last year, we did have operated in the USEME division, a curriculum development pro-

gram in the calculus, which, of course, is the early part of the undergraduate mathematics curriculum, and in engineering.

We have not yet begun, in a full-fledged sort of way, comparable kinds of curriculum development activities in the other disciplines. But the research directorates at NSF are doing planning activities for curriculum development activity in those other disciplines this year and are proposing a much more serious—or much greater emphasis on that kind of activity next year.

So we've just begun. We have just begun that kind of activity with last year's awards.

Mr. WALGREN. And that has focused on the first two years of college, I gather.

Dr. WATSON. Not exclusively, no. I don't mean to say that they are exclusively that, but certainly our advisors tell us that that is where the greatest problems are and we will—I—we will emphasize the first two years. Of course, the calculus program is the first year or two of any college program, so that's—that one is exclusively that way.

Mr. WALGREN. I guess the calculus program falls under the category of trying to prepare somebody for the first year of engineering.

Dr. WATSON. Well, that's certainly one of its—it prepares most people for most all of the disciplines, but engineering is certainly a prime receiver of the products of the calculus course, no question about that.

Mr. WALGREN. But it's something that is sort of left out or not reached by the high school programs in many instances?

Dr. WATSON. It is still not the typical course that's taken by the high school senior. There is advanced—what's called advanced placement calculus taught in some high schools and taken by some students, but college-level calculus is still the—sort of the premier undergraduate mathematics course for most students.

Mr. WALGREN. I guess what I'm trying to wonder is if you're willing to take on the responsibility to prepare them in calculus somewhat, why aren't you willing to take on the responsibility to prepare them in a number of other mission areas? And—and particularly, when we—when you—if they're willing to—to broaden their objectives from simply educating researchers into feeling that they have a responsibility, that the National Science Foundation has a responsibility for the—the—they go so far as to spend money on scientific literacy, although I don't know whether that's—that's very broad, but technological capability of the citizenry, as opposed to their—what they think about democracy and making good judgments of science through democracy, the technological capability of our people, I would think that there would be a lot of things, other than calculus, that you would be trying to fill in that first-year-college, last-year-high -school gap, where the high schools are not performing as well as we would hope they would and graduating people who have literacy problems, just plain reading.

I would think that there would be so much fertile ground that would help students do well technologically, that the National Science Foundation would have leapt into that void and yet, they have—they have completely stayed away from it.

I guess I'm wondering why.

Dr. WATSON. Well, that may go a little bit beyond my scope, but I would say certainly it is a budgetary consideration. The—the calculus and engineering programs were initiated originally first because of a perception that those were the areas of greatest concern.

The other areas, the chemistry, the physics, biological sciences and so forth, which are in a planning mode this year in NSF's research directorates, and which would then begin full-scale activity next year in the plan, have come along a year or two years later than the calculus and engineering activities because of a perceived priority.

Mr. WALGREN. Well, I just hope very much that the combination of the congressional interest and the need will—will encourage the NSF on its own motion to try to show it can be done in these areas that are essential to—to—what you might call basic science education.

And—and I would think that there would just be all kinds of things that don't cost a lot of money that would be interesting to pursue and you may be able to really show the way that something can be picked up and replicated on a very wide basis. And even in an area where you've got women and minorities largely represented at a time in their lives where they're trying for self-improvement and certainly they're open to the process, if they ever are, and we have nothing for them.

That's—that seems to me to be a real gap in what we should be doing when you consider how we are trying to pick up this educational responsibility in many ways from first grade on through the National Science Foundation willingly, and yet, we come to this point and just find the Science Foundation, having taken no real initiatives at all until now—they're being pushed into the area, but still reluctant. That's a great disappointment.

Well, the—you know, I don't like to see us feel that we're discharging our responsibility because proposals have not been—numbers of proposals may not be as intensively submitted as others or that faculties have some kind of—where did you say it in here—"little experience or tradition with the development of proposals at two-year colleges."

That's really not a good place to hang the hat of doing nothing, and—because, believe me, if we don't take the initiative to bring in the women and the minorities, we're going to be awfully short as a society 20 years from now, and it will be the fault of everybody who had an opportunity to show how that could be done.

And the NSF has a beautiful opportunity to show how that can be done. You could even do it under the rubric of doing research. The concept of—of causing a demonstration to happen on the—as research in showing how something can happen or trying to make it happen, which is really in the broad definition educationally what you're talking about, you're not even far off the home base of the doggone National Science Foundation at that point.

And you can make a great contribution in the process if we could get you there.

Dr. WATSON. I agree.

Mr. WALGREN. Well, okay, I want to express my appreciation, Dr. Chubin, for your participation, especially on relatively short notice,

and we appreciate your reinforcement of what NSF may be trying to find as useful in this dove-tailing of the curriculum and I'm sure good things can come from that.

The—I'm trying to think, Dr. Chubin, other than support for students directly as scholarship or student loans, do we see much Federal money going to community colleges in any way, shape or form for education?

Dr. CHUBIN. I had an answer to the previous question.

Mr. WALGREN. Okay.

Dr. CHUBIN. May I make an observation and then we'll—I'll try to say something about that?

I think—without presuming to speak for NSF, that their main business has been the research work force and the research work force is not the same as the whole science and engineering work force, which I think is the concern that we've heard discussed, certainly in the first panel today.

And that part of the—anybody who's worked with peer review systems or merit review, as NSF calls it, knows that the criteria that are used for evaluating proposals vary from program to program, depending upon program objectives. And that what we're hearing from—I believe what I heard from the gentlemen who were testifying in the first panel, is that they haven't been successful and, after a while, when you're not successful, the behavior is extinguished and the proposal pressure wanes and NSF sits up and says, "Well, there's no demand out there. I mean, there's nobody who's interested in doing this work," so that there is some self-selection that goes on.

One simple-minded remedy, and it may be rejected purely on those grounds, is that one could certainly amend the criteria that are used in various programs at NSF where community college proposers would submit proposals without at all undercutting merit review. I mean, I believe this has been done for proposers for other categories of institutions.

I mean, as we know, this whole slew of programs that exist at NSF are targeted to speak to different kinds of issues, getting more minorities involved, getting more research support for women. I believe that the so-called research colleges have made the claim in the past that they're—that they themselves are performing a special function in sending students on for graduate study in science and engineering, but that because of their heavy course loads—after all, they are teaching institutions, that somehow they were being discriminated against in the review process, and that they wanted some sort of equivalent credit for being at a teaching—a predominantly teaching institution, but also doing research, and then added, as I think was a very effective—a very effective addendum, that they've got a high proportion of their undergraduate students collaborating with them in technical publishing.

So that they demonstrated that they were reinforcing the research role, the kind of undergraduate research experience that Dr. Watson's program is certainly trying to advance.

So my one suggestion is simply that—that NSF could look at the criteria for various programs now in effect, or also think about new programs.

Insofar as your question about financing of community colleges, my understanding is that most of that money comes from State and local government. In the Higher Education Act that I refer to in my testimony, there is as many—in one of the attachments, there's listed, as of 1986, over 1000 cooperative education programs that exist, and 40 percent of those are at two-year and community colleges, and 30 percent of those programs are oriented to engineering.

So there are already in place mechanisms for supporting this transfer function, transfer both to the work force and to the four-year institution.

Mr. WALGREN. And those programs are funded from what level?

Dr. CHUBIN. Well, as part of Title 8, I guess that would be administered by the Department of Education.

Mr. WALGREN. And they are largely in engineering?

Dr. CHUBIN. Well, 30 percent of them. The last data that we saw indicated 30 percent of those programs were engineering-oriented.

Mr. WALGREN. What kinds of support would you find under there?

Dr. CHUBIN. It's, I think, operational expenses for the most part, that the host institution, where the student's attending, gets some overhead money so that a fraction of the faculty member's time can be spent in counseling and in doing the liaison work with the placement company.

Mr. WALGREN. And do you have any idea how much money overall goes under those programs to community colleges?

Dr. CHUBIN. No, but I think that they peaked out quite a while ago. That's one of the reasons why we—we selected the word "revisit." I mean, it's one of these—there was a very clear increase in those programs and in students going into them when the Federal Government was supporting them, and the heyday was the mid-70s, and since that time, the programs have continued with a lot of State—some State, a lot of local and a lot of corporate financing.

But I think the Federal Government has, for the most part, removed itself.

Mr. WALGREN. I see.

Well, okay. I want to thank you for coming, both of you, and again state that we're going to be trying to pursue the National Science Foundation, Dr. Watson, to see if we can't get greater initiative taken in this area because perhaps we're pressing you into—not you, but perhaps we're pressing the Foundation into areas that it would rather confine itself to just satisfying itself with the extent of the research personnel being adequate, but that's not a big problem. All we'd have to do is bring researchers from around the world to the United States. We could pay them to come and we'd have a wonderful research base, but our society would be largely left out in the process. That's not what we intend to see happen.

So clearly, as I believe they have in the education function of NSF, taken a very broad responsibility and once you take that—if you take that broad responsibility, there's a—there's a great big gap in the two-year and in the community college involvement. And I hope that you can help us fill that gap.

Dr. WATSON. We'll try.

Mr. WALGREN. Okay. Thank you very much.

The third panel today is made up of Dr. John Clevenger, of Truckee Meadows Community College in Reno, Nevada; Dr. John Alexiou, the Vice President of Education at Miami-Dade Community College and Dr. Robert Menefee, of Montgomery College, in Gaithersburg, Maryland.

We appreciate your joining us, gentlemen, and particularly sitting through what is a long afternoon, but we are particularly interested in the things that you have been doing, particularly in programs in science and math and technical instruction, and also on women and minority students and their potential.

Let's start with Dr. Clevenger and go through your presentations in the order in which I introduced you to the record.

STATEMENTS OF JOHN CLEVENGER, DEPARTMENT CHAIR, SCIENCE AND MATHEMATICS DEPARTMENT, TRUCKEE MEADOWS COMMUNITY COLLEGE, RENO, NEVADA; JOHN ALEXIOU, VICE PRESIDENT OF EDUCATION, MIAMI-DADE COMMUNITY COLLEGE, MIAMI, FLORIDA; AND ROBERT MENEFEE, DIRECTOR, SCIENCE AND MATHEMATIC PROGRAMS, MONTGOMERY COUNTY COMMUNITY COLLEGE: GAITHERSBURG, MARYLAND

Dr. CLEVENDER. Okay. Thank you, Mr. Chairman.

I am a chemist and chairman of the Science Department at Truckee Meadows Community College. I have taught in two-year colleges for 18 years. I'm also chairman of the Committee on Chemistry in the Two-Year Colleges and a member of the Task Force on Two-Year Colleges, both of which are activities of the American Chemical Society.

For some time, I've been concerned about what's become known as the science/education pipeline and, until recently, the lack of recognition of the crucial role that two-year colleges play in directing students into this pipeline.

I'm pleased to see a growing awareness of the importance of two-year schools. This hearing's an excellent example.

These colleges now make up the largest single segment of the nation's higher education system. In addition to minorities, they educate a high proportion of nontraditional college-age women returning to formal education and changing careers.

We can serve to increase the numbers going through the pipeline, but we also serve as a point of reentry to those students who left earlier. For example, at my own institution, the average age is 32; 56 percent of those people are women. My typical student is female, somewhere in late to—20s to late 30s, with a family.

Two-year faculty are often the first line of communication between the nonscientific citizen and the scientific community. Because we know our students and community well, we become the local science expert. We get called to answer questions ranging from household cleaner effectiveness to the consequences of a chemical spill.

The mission of these institutions is in the teaching branch of higher education, which is distinguished from the research branch. In chemistry education, they have a strong commitment to provide the first two years of college equivalent to that of any four-year col-

lege or university; to increase scientific literacy of nonscience students; to prepare students for employment as chemical technicians or in chemically related technologies; and to upgrade the technical skills of our nation's work force.

The proposed legislation to establish a national advanced technician and training program at two-year colleges, I believe, is an excellent recognition of these last two points.

An important feature of two-year science programs is the high level of interaction between teaching faculty and their students. Two-year students are often the first in their family to pursue postsecondary education. Our faculty serve as role models for these students. Laboratories, which are typically taught by the faculty member, not a graduate student or a teaching assistant, provide close opportunities for interaction. Generally, classes are small; faculty members readily accessible in and out of the classroom.

These factors have been identified as important for retention of nontraditional students. NSF and others have shown a national decrease of 40 percent in science-oriented students during the first year of college; however, at two-year colleges, the decrease is only 14 percent after two years.

Federal research and development funds influence the nation's entire science and engineering effort. Because of two-year college's role, directing more funds into improving these colleges will signify a real national commitment. However, they have serious problems at these colleges. Faculty teach long hours; they have few resources, time, or encouragement for professional growth. There're often limited funds to upgrade inadequate and obsolete equipment.

Large numbers of the students enrolled are under-prepared and so require extensive development and time commitments from faculty.

In responding to part of these problems, the NSF, through its Division of Undergraduate Science, Engineering and Mathematics, has opened its doors to two-year colleges, in particular, the instrumentation programs have been beneficial. The staff of the Undergraduate Sciences Division has been extremely supportive. We look forward to building that relationship.

However, there must be additional support in the areas of laboratory and instructional development. I urge that the Undergraduate Science Division become a strong central unit for these programs. It should be highly visible, with adequate funds for such projects as umbrella grants to professional associations which could then make smaller grants to individual colleges; to support a number of regionally located and well-equipped model science laboratories and two-year colleges; support for laboratory development, particularly appropriate at two-year schools; encouragement and support of new programs to take full advantage of modern technologies which are appropriate for the first two years of science instruction. These might include interactive video disks of computer simulation.

The area of faculty development is perhaps more difficult. Two-year college faculty must stay current to teach well. Because our expertise is in teaching, and not chemical research, it's often assumed that we already have our education so we're set for our teaching career. However, two-year college faculty need support for

scholarly pursuits to remain current and effective teachers and to use modern technologies and instrumentation.

Of course, NSF or other agencies, cannot send all deserving two-year college faculty to conferences and workshops, but a well-publicized prestigious program specifically targeted at two-year faculty would bring national recognition to the accomplishments of these faculty and signal the need for funding from all agencies.

We need to indicate to those who teach introductory courses in nonscience majors courses that they're valued educators and contributors. We say this publicly, but we direct the reward system, such as grants and research funds, towards others. We even use the term "research opportunity," but speak of a teaching load.

There should be a long-term commitment to a broad range of faculty development opportunities for two-year college faculty. These might involve grants to professional associations, which could make mini grants to attend workshops. We need to establish faculty development opportunities, such as summer institutes, conferences, weekend seminars.

We also need to establish programs to provide service for those not able to attend conferences and workshops. This could be done through a combination of printed materials, modern instructional developing—delivery methods.

I believe that these issues can best be addressed through an enhancement of the NSF Division of Undergraduate Science, Engineering and Mathematics Education, which goes under the acronym, USEME. Support of these activities through the research directorates, although well-intentioned, will not give the strong national commitment that two-year colleges need.

I encourage and applaud the two-year college initiative at NSF, but have some concerns about their proposed mechanism. NSF should support a broad range of laboratory, curriculum and faculty development activities.

One aspect of this broad support should be to establish partnerships among two-year colleges and also with the four-year colleges and universities. The communication and collaboration are essential.

However, the formation of consortia with lead or central four-year colleges and universities and several area two-year colleges will not bring the national development momentum that is needed for two-year colleges. For all of the excellent work of four-year colleges and universities, their mission is different. Their programs are often developed by research-oriented faculty, for large sections of students, and are not always appropriate for two-year colleges.

In conclusion, the Federal agencies need to provide strong and leveraged support to call attention to the critical role of two-year colleges. There need to be two-year college experts in the high-level advisory boards, such as the National Science Board, and the staff of the agencies.

There need to be specific national programs recognizing the important role of two-year colleges in science education. I believe these things can and must be done.

Thank you for your interest and your time.

[The prepared statement of Dr. Clevenger follows:]

STATEMENT

of

DR. JOHN V. CLEVENGER

Science Department Chairman
Truckee Meadows Community College
Reno, NV

to the

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

regarding

TWO-YEAR COLLEGE SCIENCE EDUCATION

TUESDAY, APRIL 11, 1989

Mr. Chairman and Members of the Subcommittee:

My name is John Clevenger. I am a chemist and Chairman of the Science Department at Truckee Meadows Community College, in Reno, NV. I've taught in two-year colleges for eighteen years. I'm also Chairman of the Committee on Chemistry in the Two-Year Colleges (a), and a member of the Task Force on Two-Year Colleges, both activities of the American Chemical Society. I request that my complete statement be entered into the record. {written statement, Critical Issues, Guidelines, $2YC_3$ Newsletter}

For some time I've been concerned about what has become known as the science and engineering education pipeline and, until recently, the lack of recognition of the crucial role that two-year colleges play in directing students into this pipeline. This hearing is an example of the growing awareness of the importance of two-year colleges in upgrading the nation's workforce and the population's general scientific literacy.

Recent reports indicate our nation faces a future shortage of science and engineering professionals and a current lack of general scientific knowledge.[1,2] In addition, by the year 2000, 85% of new entrants to the nation's workforce will be members of minority groups and women, groups which have historically been underrepresented in science and engineering.[2] The nation can meet these challenges only by reaching out to these under represented groups and the general public within our communities. Two-year colleges can make a significant impact in this area.

Two-year colleges now make up the largest single segment of the nation's higher education system, enrolling more than 50% of entering freshman and 43% of the total undergraduate population.[3,4] They also enroll more than half of all Hispanics and American Indians (55%), and approximately 40% of all Asians and Blacks in higher education.[5] In fact, 80% of minorities in higher education enter through a two-year college.[6]

Two-year colleges also educate a high proportion of non-traditional college age women returning to formal education and changing careers. Not only can we serve to increase the number of women and minorities going through the pipeline, but we can also provide a point of re-entry to those students who had left earlier.

These are truly "community" colleges who currently serve large numbers of potential scientists and scientifically literate citizens, particularly those currently underrepresented in science education. For example, at my own institution the average student age is 32 and 56% of our students are women. The percentage of minorities served parallels that of the service area. (b) Because of this community involvement, 2YC faculty are often the

first line of communication between the non-scientific citizen and the scientific community.

The mission of these institutions is in the teaching branch of higher education as distinguished from the research branch. In chemistry education they have a strong commitment to:[7]

- provide the first two years of college, equivalent to that at any four-year college or university;
- increase the scientific and technological literacy of nonscience students;
- prepare students for employment as chemical technicians or in chemically related technologies;
- upgrading technical skills of our nation's workforce

An important feature of 2YC science programs is the high level of contact between teaching faculty and their students. 2YC students are often the first in their family to pursue post-secondary education. 2YC faculty serve as role models for these students. Laboratories, typically taught by the faculty member, not a graduate student or teaching assistant, provide opportunities for close interaction.[7] Generally classes are smaller than at 4YC, with the 2YC faculty member being more accessible in and out of the classroom. This has been identified as important for retention of nontraditional students.[8]

As a national leader in science and engineering research and education, the National Science Foundation's Long-Range Plan, FY 1989-1993 contains three main objectives.[9]

-Ensure an adequate number of high-quality scientists, engineers, and technical personnel;

-Encourage groups now underrepresented in science and engineering both to undertake careers in those fields and to stimulate all institutions to participate more fully in developing scientists and engineers;

-Improve the science and technology literacy of the general public.

Federal research and development funds influence the nation's entire science and engineering effort. Since 2YCs play such a major role in educating women, minorities, and the general public,(others are <u>just now getting interested</u>, we've been doing this all along) directing more funds into improving these colleges would signify a <u>real</u> national commitment.

However, these colleges face serious problems.

-Faculty teach long hours with few resources or time for professional growth.

-There are often limited resources to upgrade inadequate and obsolete equipment.

-Large numbers of the students enrolled are underprepared and so require extensive development and time commitments from faculty.

Responding to part of these problems, the NSF has opened its Instrumentation and Laboratory Improvement (ILI) program to 2YCs and has been extremely supportive in this area. Scientists teaching in 2YCs are quite pleased to be able to participate and look forward to submitting more quality proposals in the future.

However, there must be additional support in the areas of laboratory and instructional equipment. There should be:

- umbrella grants to professional associations (or state 2YC agencies) which could then make smaller disbursements to individual colleges submitting proposals for the purchase of instruments costing under $3,000;
- support for a number of regionally located and well-equipped, model science laboratories in two-year colleges;
- encouragement and support for new programs to take full advantage of modern technologies appropriate for the first two years of science instruction, such as interactive videodisks, compact disks, and computer simulation, that would enable 2YCs to bring enhanced learning opportunities to their students.

The area of faculty development opportunities is more difficult. 2YC faculty must stay current to teach well and to help the nation remain competitive. Because our expertise is teaching and not chemical research, it's often assumed that we already have our education so we're set for our teaching career. However, 2YC faculty need support for scholarly pursuits to remain current and effective teachers and to use modern technologies and instrumentation.

Although NSF (or other agencies) cannot send all deserving 2YC faculty to conferences and workshops, a well publicized, prestigious program, specifically targeted at 2YC faculty would bring national recognition to the accomplishments of these faculty and signal the need from all funding agencies (national and local) that this is an important area.

We need to indicate that those who teach introductory courses and non-science majors (scientific literacy) courses are valued educators and contributors. We say this publicly, but direct the national reward system (such as grants, research funds, and reduced teaching loads) toward others.

Part of the problem is that many spokespersons for national reform in science education have little or no contact with the average student in an average introductory science course. One of the reasons that you often don't hear from 2YC faculty in these areas is that they have so little time or encouragement for scholarly activities. { For example, for me to appear before you today involves problems such as travel money and finding

someone to teach my courses, since I am the only chemist on the faculty. This is difficult or impossible for many 2YC faculty.}

There should be a long-term commitment to funding projects that involve staff development for 2YC faculty and instructional research and development by and for 2YC faculty. These might involve:

- umbrella grants to professional associations (or state 2YC agencies) which could then make smaller disbursements (minigrants) to individuals to attend professional conferences and workshops or work on a specific professional or curriculum development project;
- establishment of programs to provide additional in-service education to 2YC faculty who are unable to attend conferences and workshops. This could be done through a combination of printed materials and more modern, instructional delivery methods, such as teleconferencing, video tapes, and interactive video disks;
- re-establishment of faculty development opportunities for college science teachers, such as the College Science Improvement Program (COSIP), that are scheduled during times when faculty can participate.

The Federal agencies need to provide strong and leveraged program support to call national attention to the critical role of 2YCs. There need to be 2YC experts in the high level advisory boards of these agencies. There need to be specific national programs recognizing the important role of 2YCs in science education. For example, the NSF has targeted academic research in those states which historically have received the least federal research funding through EPSCOR (Experimental Program to Stimulate Competitive Research). This program ensures that these states have an opportunity to build strong science and engineering programs. Could similar "flagship" programs be targeted at 2YCs scholarship and development? I believe it can and must be done.

Thank you for your interest and your time.

FOOTNOTES

(a) The primary goals of the Committee on Chemistry in the Two-Year Colleges are to:
   (1) Implement activities to improve the quality of chemical education in two-year colleges
   (2) Promote communication among chemistry teachers from the secondary level through the university level

To accomplish this, our major activities are:

(1) Conducting four regional Two-Year College Chemistry Conferences ($2YC_3$) annually

(2) Publishing and distributing materials to benefit our programs and two-year chemistry faculty. The primary publication is the $2YC_3$ Newsletter. We also help subsidize the publication of materials like Critical Issues in Two-Year College Chemistry: Report With Recommendations, and Guidelines for Chemistry and Chemical Technology Programs in Two-Year Colleges. Copies of these materials are included.

(b) Truckee Meadows Community College/Washoe County Service Area.
Population by Race/Ethnic Status

Race/Ethnic Status	TMCC	Washoe County
American Indian	2.3%	2.3%
Asian	3.5%	3.8%
Black	1.5%	1.6%
Caucasian	82.7%	87.9%
Hispanic	4.5%	4.4%

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Mr. WALGREN. Thank you, Dr. Clevenger. I appreciate that testimony very much.

Dr. Alexiou.

Dr. ALEXIOU. Thank you, Mr. Chairman.

I represent Miami-Dade Community College in Miami, Florida. I know that time is of the essence today and I'd like to use my time to briefly acquaint you with the college and to explain to you why I think it's important for you to understand the role that the college has had in dealing with minority and women.

Miami-Dade has a proven record of effectively dealing with large numbers of minority and under-prepared students. We could do better, but given the resources available, we have done very well.

Last fall term, approximately 46,500 credit students were enrolled at the college's four campuses. Of these, 54 percent were Hispanic and 16 percent were black, non-Hispanic. Also women constituted 57 percent of the student body.

We are, therefore, a majority/minority institution. In fact, one of every 17 Hispanic students in community colleges and one in every 28 Hispanic students in undergraduate education in the entire United States is at Miami-Dade Community College.

The college also has the largest number of international students, both visa and refugee status, of any college or university in the United States.

This minority population is more likely to arrive at the college academically unprepared. We administer a placement test mandated by the State—but we did it before that—composed of four subtests to all incoming students. Last fall, 81 percent of all incoming black, non-Hispanic students failed at least one of the subtests. Sixty-five percent of Hispanic students, collegewide, failed one of the tests. White, non-Hispanic students did not do substantially better, however, with 62 percent failure.

Students who did not meet the cut-off score requirements set by the State are placed into remedial or what we in Florida call college-preparatory instruction.

Mr. Chairman, as you know, Miami, and Dade County generally, has had large numbers of immigrants over the last three decades. The last several years, particularly, it's seen significant numbers of Haitian, Central American and Caribbean Basin immigrants. Many of these people come to Miami-Dade with significant English language deficiencies.

We also remediate in English as a second language in college preparatory instruction ESL and college-level ESL, as well as noncredit.

Our experience is that if these under-prepared students persist, completing their college preparatory course work as we ask them to, they are just as likely to remain enrolled with satisfactory grade point averages as those who have never needed remedial work in the first place.

What does Miami-Dade do to assist under-prepared students to succeed? For the last decade, the college has had in place a series of computer-assisted systems to allow students and their advisors to know where they stand in terms of their graduation requirements. We prescribe courses as indicated by test scores and progress in the curriculum.

If a student withdraws or fails a significant number of courses, we reduce the number of courses that they may take in the upcoming semester. We track students through the computer so that they better understand what is expected of them and what they need to accomplish to succeed at our institution and to transfer beyond it.

Further, we have established a curriculum which has a required core of 15 credits and a selection of 21 additional credits from a small list of distribution courses.

Given all of this, we continue to graduate significant numbers of minority students generally and in the sciences and mathematics particularly. In the last academic year, 1987 to '88, of the 2707 associate in arts graduates, AA graduates, 23 percent indicated a transfer major in the sciences and math. Of that 23 percent in the sciences and math, half were Hispanic, 11-1/2 percent were black, non-Hispanic, and 38.5 percent were female, which roughly approximates the incoming percentages.

Similar percentages are found in the associate in science degrees granted that year, although the percentage of female AS graduates was higher at 63 percent and that's partially due to the allied health and nursing fields.

Minority students succeed at Miami-Dade and are an important resource to the local economy and the national work force. The College Board Yearly publishes a talent roster of outstanding minority community college graduates. This year, 1989, Miami-Dade Community College has 530 students listed. That's 13 percent of the entire national listing and 88 percent of Florida's.

Thus, Miami-Dade Community College has more outstanding minority graduates, according to the College Board listing, than any State in the Union, save California, and community college students in Florida transfer to four-year institutions for baccalaureate study. Fifty-eight percent of all upper division enrollments in the nine State universities are community college transfers and 54 percent of all science and technology upper division students are community college transfers.

The post-secondary education system in Florida is somewhat unique, although it's based on the two-plus-two concept that you find in other States. It has been the expectation of the Florida legislature that affordable post-secondary education should be within easy reach of all residents of the State at community colleges.

This two years of community college work, for large numbers of students, is then followed, as it is elsewhere, by junior and senior years at the State university. However, in Florida, to ensure the ease of transfer and the protection of the credits earned, there is a formal legislated articulation agreement between the community college system and the State university system. There's also an articulation coordinating committee that oversees the agreement.

Problems between systems, and there are some every year, are solved by that committee. A recent study conducted by a task force of the State Board of Community Colleges found that Florida's one of the few States with a comprehensive articulation agreement legislated and in place.

Our students transfer and succeed at the State university system. Indeed, community college transfers do as well as students who start at the university level. This equality of success is present

even though native students are much more—a much more selective cohort, with relatively high SAT or ACT scores compared to a community college open-admissions policy.

In addition to transfer arrangements made with the State university system through the articulation agreement, Miami-Dade Community College has developed articulation agreements with more than 40 public and private institutions around the country. A number of these institutions have strong science, engineering and technical programs.

While minority and female students transfer to the university system and many begin there, the last year shows, unfortunately, that black students, non-Hispanic were 8- to 9 percent of the entire population; Hispanics, 8- to 9 percent; and females approximately 50 percent. Similar numbers were found in the percentage of minorities in science and technology fields, although females were under-represented at 34 percent.

Not only does the college work with universities, we have developed strong working relationships with the public school system in Dade County. We are a strong believer of the continuity of the curriculum from K through 12 through the community college to the university system. We have faculty meetings, my written testimony indicates, with public school. We also have them with university faculty as well to coordinate curriculum so that there is a smooth flow all the way through the educational system.

In short, minority and female students can and do succeed at Miami-Dade Community College. We are committed to doing better. More of our students should persist to graduation. More should persist in finding meaningful employment in the fields of their choice. More should transfer and succeed at the university level.

We have been working for the last 28 years to accomplish these tasks. That is the length of our existence, and we have more years to go to reach our goals.

Mr. Chairman, my time does not allow me to make any comments on the NSF report or your bill under consideration. On this latter point, let me indicate that the community colleges of this country serve an important purpose in science and technical education for all students. We need assistance, however, for funding is always short. Laboratories are woefully under-equipped and faculty need upgrading, and our curriculum needs work.

Any Federal support for what we do from Congress through the National Science Foundation or any other source would be gratefully appreciated.

Mr. Chairman, I'd like to thank you for your leadership in this area of enhancing science and technical education in the community colleges.

Thank you.

[The prepared statement of Dr. Alexiou follows:]

WRITTEN STATEMENT OF DR. JOHN ALEXIOU, V.P. OF EDUCATION, MIAMI-DADE COLLEGE

MIAMI, FLORIDA

MR. CHAIRMAN

MEMBERS OF THE SUBCOMMITTEE

I represent Miami-Dade Community College in Miami, Dade County, Florida. I would like to use my time today to acquaint you with the College and to explain why I think it is important for you to understand what the College has accomplished. Miami-Dade has a proven record of effectively dealing with minority and under-prepared students. We could do better, but given the resources available we have done well.

Miami-Dade is a four-campus, soon to be five-campus, College. One campus is in urban, downtown Miami, two are suburban campuses, one is a special Medical Center Campus focusing on allied health and nursing, and the newest campus will be in mostly agricultural far South Dade County.

Last Fall term, approximately 46,500 credit students were enrolled. Of these, 54% were Hispanics and 16% were Black, non-Hispanics. Also, women constituted 57% of the student body. We are, therefore, a majority, minority institution. In fact, one of every 17 Hispanic students in Community Colleges, and one in every 28 Hispanic students in undergraduate education in the entire United States, is at

Miami-Dade. The College also has the largest number of international students (visa and refugee status) of any college or university in the United States.

This minority population is more likely to arrive at the College academically underprepared. We administer a placement test, composed of four sub-tests, to all in-coming students. Last Fall, 81% of all incoming Black, non-Hispanics failed at least one of the sub-tests. 65% of Hispanic students College-wide failed at least one of the sub-tests. White, non-Hispanic students did not do substantially better, however. Students who do not meet the cut-off scores requirements are placed into remedial, or what we in Florida call, College-Preparatory instruction.

As you know, Miami, and Dade County generally, has had large numbers of immigrants over the last three decades. The last several years have seen significant numbers of Haitian, Central American and Caribbean area immigrants. Many of these people come to Miami-Dade with significant English language deficiencies. We also remediate in English as a Second Language in College Preparatory ESL and College-Level ESL.

If these underprepared students persist, completing their College Prep course work, they are just as likely to remain enrolled, with satisfactory GPA's, as those who never needed remedial work in the first place.

What does Miami-Dade do to assist under-prepared students to succeed. For the last decade, the College has

had in place a series of computer-assisted systems to allow students and their advisors to know where they stand in terms of graduation requirements. We prescribe courses as indicated by test scores and progress. If a student withdraws or fails a significant number of courses, we reduce the number of courses that they may take in a semester. We track students so that they better understand what is expected of them, and what they need to accomplish to succeed.

Further, we have established a curriculum which has a required Core of 15 credits, and a selection of 21 additional credits from a small list of Distribution courses. One of the required Core courses is an introductory Natural Science Course, and at least one additional natural science course is required from the Distribution List. This prescribed curriculum includes 9 credits in English Composition and 6 credits in Mathematics.

Given all of this, we continue to graduate significant numbers of minority students generally, and in the sciences and mathematics particularly. In 1987-88, of the 2,707 Associate in Arts graduates, 23% indicated a transfer major in the sciences and math. Of the 23% in the sciences and mathematics, half were Hispanic, 11.5% were Black, non-Hispanic and 38.5% were female. Similar percentages are found in the Associate in Science degrees granted that year; although, the percentage of females A.S. graduates was higher at 63%.

Our minority students succeed at Miami-Dade and are an important resource to the local economy and the national workforce. The College Board yearly publishes a Talent Roster of Outstanding Minority Community College Graduates. This year, 1989, Miami-Dade Community College has 530 students listed, 13% of the national listing and 88% of Florida's. Thus the College has more outstanding minority graduates listed than any state in the Union, except California.

And Community College students in Florida transfer to four-year institutions for baccalaureate study. 58% of all upper division enrollments in nine universities of the State University System of Florida are Community College transfers. And 54% of all science and technology upper division students are Community College transfers.

The post-secondary educational system in Florida is based on a 2 + 2 concept. It has been the expectation of the Florida legislature that affordable post-secondary education should be within easy reach of all residents of the State at Community Colleges. This first two years at a Community College, for large numbers of students is then followed by the junior and senior years at a State University. To ensure the ease of transfer and the protection of credits earned, there is a formal, legislated Articulation Agreement between the Community College system and the State University System. There is also an Articulation Coordinating Council which oversees the

Agreement. Problems between Systems, and there are some, are solved there. A recent study conducted by a Task Force of the State Board of Community Colleges (I served on the Task Force), found that Florida is one of a very few states with a comprehensive articulation agreement.

Our students transfer and succeed at the State University System; indeed Community College transfers do as well as students who start at the University level (native students). This equality of success is present even though the native students are a much more selective cohort, with a relatively high SAT or ACT scores, compared to the Community Colleges' open admission policy.

In addition to transfer arrangements made with the State University System through the Articulation Agreement, Miami-Dade has developed Agreements with more than forty (40) private and public institutions around the country. A number of these institutions have strong science, engineering and technical programs.

While minority and female students transfer to the university system, and many begin there, the last year shows that Blacks were 8-9% and Hispanics were 8-9% of the total university population, while females were 50%. Similar numbers are found in the percentages of minorities in science and technology fields; although, females are under-represented at 34%. Of the recent University graduates in science and technology fields, 6.5% were Black, 9% were Hispanic and 39% were female.

Not only does the College work with the Universities, we have developed a strong, working relationship with the Public School System in Dade County. We have a number of programs in place to bring minority students to the College. Also, we have had faculty meetings to coordinate curriculum so that there is a smooth flow between secondary and post-secondary education.

Miami-Dade and Dade County Public Schools participate in the Equality and Quality Project, an effort of the College Board. We are one of nineteen model collaborative efforts around the country. The EQ Project begins with the basic premise that it is not only the upper 30% of a high school class that has been "traditionally" expected to attend post-secondary education. Given the needs of the American workforce and the reality of what is expected in the workplace, fully 60-70% of a high school class needs the information skills that the College can provide.

In short, minority and female students can and do succeed at Miami-Dade Community College. We are committed to doing better. More of our students should persist to graduation. More should persist and find meaningful employment in the fields of their choice. More should transfer and succeed at the university level. We have been working for the 28 years of our existence to accomplish these tasks, and we have more years to go to reach our goals.

Mr. Chairman, my time does not allow me to make extensive comments on the NSF Report or the Bill under consideration. On this latter point, let me indicate that the Community Colleges of this country serve an important purpose in science and technical education for all students. We need assistance, however, for funding is always short. Laboratories are woefully under-equipped and faculty need up-grading. Any Federal support for what we do, from Congress through the National Science Foundation, would be gratefully appreciated. ~~I would like to spend my few minutes acquainting you with this College.~~

THANK YOU FOR YOUR TIME AND ATTENTION.

Mr. WALGREN. Thank you, Dr. Alexiou. Appreciate that testimony.

Dr. Menefee.

Dr. MENEFEE. Thank you, Mr. Chairman.

I wanted to present two aspects of science, mathematics, engineering and technology to the committee today, a local perspective and a national one.

I think after listening to the comments of the afternoon, I will change that a bit and concentrate primarily on the national perspective because of a recent experience I had. I think you should know at the outset that I did spend two years, 1979 to 1981, as a rotater in the National Science Foundation, so I have some experience inside the National Science Foundation. I'm on the line, firing line, in terms of the development of curricula. Some of your comments made in earlier questions of previous panelists prompt me to point out a couple of things, one in the area of general education, and I brought today for your examination later our report last year, which again emphasizes partnerships. This is the college's report to the community.

I read one sentence in—one paragraph from that report to you. "We at Montgomery College believe in the development of the whole person, whether preparing students for transfer to a four-year college or for direct career entry. We feel it is important that a graduate of a printing management program, for example, knows how to read, write, communicate effectively, think logically and solve problems in addition to running printing presses. That belief extends to those planning to earn a four-year degree as well as those seeking technical education."

I might add that that is not without—without some difficulty. We have had some contentious situations with regard to the amount of general education to include in technical curricula, and that's an ongoing dialogue that continues in our curriculum development processes.

Another comment I wanted to make refers to some of our activities which are directly related to the high-technology activities of our county. The high-technology industry in Montgomery County is primarily information science and, more recently, biotechnology.

The college has been actively involved in these activities and has for some time been developing curriculum response to the community. I might mention some of the [illegible] computer-aided draft and design; telecommunications and electromechanical technologies are three that were developed a few years ago.

In response to previous remarks, it would have been helpful if we had assistance in developing some of these curricula. I can recall that in the telecommunications curriculum development efforts, we researched the national scene and found that there were no other community colleges that had a similar curriculum in operation; a few that were planning them and so we had to develop our curriculum with our own resources, our local resources, and again, it would have been helpful to have some sort of national curriculum effort that could have assisted that process.

The partnership idea has been promoted here today extensively. We support that. You notice, that is the focus of our annual report

last year to the community and it's the focus of the college's interaction with its immediate community.

But in addition to our local activities, and I do want to spend the rest of my time talking about the national situation, this comes about because our president, Dr. Robert Parilla, chaired the workshop that was mentioned previously that the National Science Foundation sponsored in October, November of last year. This was an extensive effort. I was privileged to participate in that and assist in the writing of the report and so I'm going to focus today on a couple of excerpts from the report. It is much too lengthy to cover today, but I will try to get to the executive summary and go through that in some detail.

Comments I would make are these. They reiterate what's been said before. The national interest requires that more citizens select careers in the sciences, mathematics and engineering. It also requires that the level of scientific literacy be dramatically increased in the general populace.

Two-year colleges have the potential to increase the number of students in science, mathematics, engineering and technical areas. The large cohort of students they serve and the large number of undeclared majors with which they deal underscore this potential. They are uniquely positioned to increase science career interest among minorities and women and to increase the general scientific literacy of the nation's population.

The workshop group determined that the needs of introductory science education are best met by aggressive intervention in three areas: One, faculty development; two, student needs; and three, educational resources, including science, mathematics, engineering curricula and equipment.

Let me go now to page 5 and—and present the—in the executive summary, the summation of that extensive work that that—that group in the workshop body performed.

While recognizing the recent steps by the NSF are appropriate ones for encouraging and supporting the improvement of undergraduate education, the workshop group expresses grave concern that the level at which these steps are being implemented is insufficient. The budgets for the several NSF undergraduate programs are inadequate for the task and its urgency. Further, the programs have not been sufficient for addressing the needs of the two-year colleges.

Thus, the workshop group concluded that there is no way out of the worsening dilemma other than to move ahead deliberately and recapture the spirit of forward progress and leadership the nation once held. There is no equivocation about the conclusion.

The conclusions, then, were two-fold: program recommendations to the National Science Foundation and partnership recommendations, which are a bit broader. The program recommendations to the NSF are: one, establish programs or an office for introductory collegiate science, mathematics, engineering and technology to enhance lower division education. If you look at the support of higher education or the whole spectrum—the whole system of education, you see a serious inequity at the lower division undergraduate level.

Number two, support faculty development opportunities to promote and enhance the scholar/teacher concept in two-year colleges. The scholar/teacher concept, this group felt, is the basis for the faculty development efforts that are so essential in two-year institutions.

Three, support model programs and activities to attract and retain students, especially from under-represented groups, into lower division courses.

Four, establish programs that support curriculum revision and develop improved equipment and offer laboratory hands-on activities for introductory courses.

Five, establish programs that enhance utilization of computers and other technological innovations for introductory science and engineering laboratory courses.

The partnership recommendations, number six, NSF and the two-year colleges develop an on-going partnership which enhances participation of two-year college representatives in NSF activities. And I might add, from my own experience, the intention was at all levels of activity from program submission, development of proposals, program officers, peer review, membership in the national science board, all levels of activity.

Number seven, NSF establish programs to encourage formation of additional partnerships involving the two-year colleges with business, industry, universities, public schools and other institutions.

Eight, the final recommendation, the American Association of Community and Junior Colleges, the AACJC, establish a national task force for the improvement of science, mathematics and engineering education in community, junior and technical colleges, and in the course of this, they were encouraged to enlist the support of other organizations, such as those represented by Dr. Clevenger.

These were the—these were the recommendations from the workshop to the National Science Foundation. That report, I understand, will be available to the committee in—if it is not already available to you. From my own experience, it was—it was an impressive group who worked very hard for two days and two nights and analyzed the national situation and came up with what I think are significant recommendations to the National Science Foundation and to the higher education community in a broader sense, for steps that, if they are taken, would improve what the workshop felt was a serious situation at the introductory college science, mathematics and engineering education level.

Thank you very much for your time.

[The prepared statement of Dr. Menefee follows:]

SCIENCE, MATHEMATICS, ENGINEERING AND TECHNOLOGY: A LOCAL AND NATIONAL PERSPECTIVE

Dr. Robert W. Menefee
Dean, Science and Mathematics
Germantown Campus
Montgomery College, Maryland

April 11, 1989

SCIENCE, MATHEMATICS, ENGINEERING AND TECHNOLOGY

IN MONTGOMERY COUNTY, MARYLAND

The Montgomery County High Technology Industry and Montgomery College: A Continuing Partnership

- Montgomery College through its planning process and a resulting diversity of activities has provided consistent support for economic development and the high technology industry in the County. The College has a long association with the County Office of Economic Development and The High Technology Council.

- College forecasts and objectives have specifically cited economic development and high technology. Subsequent interactions of College personnel with government, agency and industry personnel have produced a wide variety of cooperative ventures.

- Under the Systems Engineering Technology umbrella, curricula at the Germantown Campus in Computer-aided Drafting, Telecommunications and Electromechanical Technologies were developed with extensive local high technology industry participation. Similarly, a Biotechnology Laboratory Assistant curriculum was recently completed.

- Technical Curriculum Advisory Committees provide continuing input from local high technology employers to ensure appropriate content and current practices.

- Continuing education is a significant element of college activity providing courses for degree holders in rapidly changing subject areas related to high technology. Courses involving application of computer software packages have grown rapidly in recent years.

- Non-credit courses and contract courses are offered at sites convenient for employees. Responses to employers are rapid and growing.

- The College is not only responsive but proactive through program efforts to provide for the needs of students and industry through innovative partnerships.

- The institute for Technical Education is a joint County-College effort to provide technical facilities through College fund raising efforts augmented by County contributions.

. Traditional basic science and mathematics support of technology continues. The College recently provided input to the National Science Foundation regarding two-year colleges. The President, Dr. Robert E. Parilla, chaired a national two-day conference of two-year college educators and industry representatives to prepare recommendations for the foundation. These recommendations are contained in the following excerpts from the "Report of the Two-Year College Workshop" which took place October 31 through November 1, 1988.

SCIENCE, MATHEMATICS, ENGINEERING AND TECHNOLOGY IN THE NATION

Background

The national interest requires that more citizens select careers in the sciences, mathematics, and engineering disciplines. It also requires that the level of scientific literacy be dramatically increased in the general populace.

The community, junior, and technical colleges are an important and integral part of American higher education; the Workshop Group believes these institutions must and can play a vital role in addressing of the Nation's scientific work force needs of the future. Over five million credit students, including 55% of first-time college students, are attending these two-year institutions. Also, 42% of black students, 54% of Hispanic students, 43% of Asian students and over 50% of all women collegiate students are in two-year colleges.

Increasingly, the two-year colleges are producing students who continue on to baccalaureate and graduate degrees in science and engineering.

While the pool is large, the percentage of two-year college students who choose and remain in science, mathematics and engineering programs is small (as in four-year institutions). This is particularly true for students traditionally underrepresented in careers in these disciplines, especially minorities and women. The entire group of two-year college students is a largely untapped source of scientific personnel for the Nation. For millions of students the two-year colleges represent the last realistic opportunity to elect an interest in science, mathematics or engineering or to improve their scientific literacy through formal study.

Two-year colleges have the potential to increase the number of students in science, mathematics, engineering and technical areas; the large cohort of students they serve and the large number of undeclared majors with which they deal underscore this potential. They are uniquely positioned to increase science career interest among minorities and women and to increase the general scientific literacy of the nation's population. The community, junior and technical colleges can accomplish these objectives through the formation of partnerships with four-year colleges and universities; with precollege education units; with business, industry and Government laboratories; with professional organizations in the science, mathematics and engineering areas; and among the two year colleges.

It is recognized that NSF has taken several steps recently that are designed to encourage and support the improvement of undergraduate education. The members of the Workshop Group affirm the need and the appropriateness of these steps and express grave concern that the Government response has been insufficient to even "stem the tide" let alone begin to resolve the issue. While the organizational response of the NSF to those recommendations was the creation of a Division of Undergraduate Science, Engineering and Mathematics Education and an exciting new slate of educational programs, funding support is inadequate to the task and its urgency. In particular, the budgets for the several NSF undergraduate programs offered in FY 1988 (Undergraduate Curriculum Development in Engineering; Undergraduate Curriculum Development in Mathematics: Calculus; Instrumentation and Laboratory Improvement; Undergraduate Faculty Enhancement; Research Experiences for Undergraduates; Career Access Opportunities in Science and Technology for Women, Minorities and the Disabled) do not even begin to address the need. The requests of the proposals for each of these programs were many times the funds available. This response showed that there are a great variety of significant ideas offered by the community, a large number of capable citizens ready to contribute their considerable talents to the cause, but, for a lack of adequate funding, execution is stymied. The Workshop Group thus concluded that there is no way out of the worsening dilemma other than to move ahead deliberately and recapture the spirit of forward progress and leadership the Nation once held. There is no equivocation about the conclusion. Much more needs to be done if undergraduate education in engineering, mathematics, and the sciences is to serve the Nation adequately.

It is imperative that the Nation: (1) increase the number of students, especially women and minorities, in science, mathematics, engineering and technology; and (2) increase the scientific literacy of the general populace. Therefore, the Two-year College Workshop Group offers the following recommendations.

General Needs

The Workshop Group determined that the needs of introductory science education are best met by aggressive intervention in three areas: (1) faculty development; (2) student needs; and (3) educational resources, including science, mathematics, engineering curricula and equipment. These are consistent with the needs of the two-year colleges identified in the National Science Board Report (NSF 86-100), Undergraduate Science, Mathematics, and Engineering Education (p. 34) and in the Report of the Critical Issues in Two-year College Chemistry Conference (pp. 4-5).

20-696 - 89 - 5

EXECUTIVE SUMMARY

While recognizing that recent steps by the National Science Foundation (NSF) are appropriate ones for encouraging and supporting the improvement of undergraduate education, the Workshop Group expresses grave concern that the level at which these steps are being implemented is insufficient. The budgets for the several NSF undergraduate programs are inadequate for the task and its urgency. Further, the programs have not been sufficient for addressing the needs of the two-year colleges.

Thus, the Workshop Group concluded that there is no way out of the worsening dilemma other than to move ahead deliberately and recapture the spirit of forward progress and leadership the Nation once held. There is no equivocation about the conclusion.

Program Recommendations

1) Establish programs (or an office) for introductory collegiate science, mathematics, engineering and technology to enhance lower division education.

2) Support faculty development opportunities to promote and enhance the scholar-teacher concept in two-year colleges.

3) Support model programs and activities to attract and retain students, especially from underrepresented groups, into lower division courses.

4) Establish programs that support curriculum revision, develop improved equipment and offer laboratory "hands-on" activities for introductory courses.

5) Establish programs that enhance utilization of computers and other technological innovations for introductory science and engineering laboratory courses.

Partnership Recommendations

6) NSF and the two-year colleges develop an ongoing partnership which enhances participation of two-year college representatives in NSF activities.

7) NSF establish programs to encourage formation of additional partnerships involving the two-year colleges with business/-industry, universities, public schools and other institutions.

8) The American Association of Community and Junior Colleges (AACJC) establish a National Task Force for the Improvement of Science, Mathematics and Engineering Education in Community, Junior and Technical Colleges.

References

NSB Task Committee on Undergraduate Science and Engineering Education, "Undergraduate Science and Engineering Education," National Science Board, March, 1986.

"Critical Issues in Two-year College Chemistry," Report with Recommendations, American Chemical Society, 1986, 12 pages.

"Building Communities: A Vision for a New Century," Report of the Commission on the Future of Community Colleges, American Association of Community and Junior Colleges, 1988, 26 pages.

"Short Courses for College Teachers, Faculty Development Program," 1988-1989, Chautauquas National Center, University of Dayton, Dayton, OH 45469-001.

Office of Technology Assessment, "Educating Scientists and Engineers: Grade School to Grad School," June, 1982.

Mrs. MORELLA. [presiding.] I want to thank you, Dr. Menefee, and I want to thank the panel for your presentation. I'm sorry that I missed hearing Dr. Clevenger and Dr. Alexiou. I understand, though, that the testimony of this particular panel was excellent. It was absolutely superlative, so I give you a grade of A and tell you that we have your statements here before us.

Dr. Menefee, as I mentioned, I am pleased that you represent the college where I taught and I'm very pleased with what is being done at the community college, and I understand that at Miami-Dade we have an incredible program that deals with bringing women and minorities into the program, from what I have learned, so we look forward to learning from it.

To all of you, the question, what current linkage do you have with the National Science Foundation? For instance, Dr. Menefee, listening to your recommendations—and I appreciate the fact that they are substantive and specific and look like they should have been done all along—and I wondered for all of you, what linkage do you now have? Do you communicate with NSF? Do they listen to you? What is the situation?

Maybe you want to start off, Dr. Menefee.

Dr. MENEFEE. Yes, I have, because of personal associations with my former—former period of time there with the National Science Foundation, but I might—I might add that in a professional way, the opportunities for the faculty that I serve to be involved with the National Science Foundation are very limited. And the reasons for that have been discussed earlier.

The focus of their programming has not been at the two-year institution level. The types of activities have not focused on the preparation of the human resources that are going to be needed in the future. I think that's a mistake. I think that they are beginning to recognize that and to make efforts to rectify that.

My only suggestion would be that that—those efforts be accelerated and we find some way to involve this—this tremendously important development in higher education that we call two-year institutions, to get them involved in the National Science Foundation and the National Science Foundation, in turn, be involved in a partnership arrangement so that some of the problems that have been alluded to today in the past disappear in the near future.

Mrs. MORELLA. Were the recommendations of the workshop sent to the National Science Foundation?

Dr. MENEFEE. They were sent to the National Science Foundation. In fact, they were delivered to Mr. Block on the last day of the conference in an oral presentation and then subsequently, the report was written and has been delivered to the SEE Directorate.

Mrs. MORELLA. Would you like to comment, Dr. Alexiou?

Dr. ALEXIOU. We've had—Miami-Dade has had—I think the phrase would be "marginal" luck with the National Science Foundation over the years. This year, we did get a small instrumentation grant, I think, of 11-1/2 thousand dollars which does not do a great deal. It was under-funded from, I think the request of 16,000.

I know that some of our faculty have been used as reviewers. I had a very useful conversation just two weeks ago with staff in the Teacher Enhancement Directorate about some possibilities of curriculum updating in our natural science course. There has been

some. It seems to me that there is an opening up at NSF for community colleges, but it's just a small crack in the door and I would agree with my colleagues on this panel and some other comments earlier that if we could just shove that door open just a little bit more and provide some opportunities, we have students and faculty that could well benefit from some of the leadership of NSF and some of the funds that are available through that foundation.

Mrs. MORELLA. Dr. Clevenger.

Dr. CLEVENDER. My relationship has grown considerably in the last year. Previous to that, in the mid-70s, I was co-director of an NSF project back when they had something called the Cause Grants. Those were discontinued with the previous administration.

When NSF opened up its instrumentation program, they very carefully, and I thought well invited two-year college faculty to be members of the review panel. This year, I was a member of one of those panels.

What I saw was not only the ability to do reviewing and comment, I think, on a lot of different levels, because you see not only two-year grants, but those from all levels.

What was going on was, I think, a mutual education, and I think that's productive. What I saw there was discussions with two-year faculty about the nature of a two-year school, what they are, how they work, and educating not only the panelists, but the NSF staff, and I think also the two-year faculty are beginning to learn a lot about that process.

One of my roles as chair of the Committee on Chemistry in the Two-Year Colleges, I extended an invitation to NSF to send staff to those conferences and I just flew here from Dallas where they very nicely had two faculty—or two staff members there. We had a total attendance of over 90 people at that conference. These are two-year faculty. This was an announced program late in the afternoon; no one had eaten lunch and half of those people stayed, took diligent notes. That's a growing relationship.

We plan on continuing that at other conferences. What I'm concerned about is that's only one program. We have—my organization has put in a proposal to the undergraduate faculty enhancement. Like all other proposals, I think it should be reviewed on its merits, but I want to encourage that interaction to be extended and I think the proactive thing of NSF coming to our conferences, interacting with two-year college faculty, is one of the most positive things I've seen. I would like to compliment them.

Mrs. MORELLA. Good.

What I'm going to suggest is our subcommittee take these recommendations, if you would agree with the recommendations the workshop came up with, or if you'd like to alter them, you can submit it for the record, and ask the subcommittee to request the National Science Foundation to respond to them. I think that way we can be kind of catalysts to find out what they—maybe they have a response already prepared that they would share with us, but if not, to give them further impetus to do that.

I'm also curious about your linkage with four-year colleges. Do you sometimes have your faculty or your students share advanced courses? Maybe some of your faculty share courses at the four-year institution or students can do that?

Do you have a linkage with four-year universities?

Dr. ALEXIOU. We—

Mrs. MORELLA. Anything special that ties into science and math?

Dr. ALEXIOU. We have a—we have a discussions under way with the School of Engineering at Florida International University, which is the Miami University of the State university system. And what we're talking about and hope to implement in the fall term is faculty sharing where one of our—two of our faculty go to FIU to teach upper division courses to get a flavor of some opportunities that they wouldn't have otherwise at Miami-Dade and some of FIU faculty then coming and teaching undergraduate courses at the college to get a flavor of incoming students and what our faculty have to deal with.

I think the outcome of that will not only be shared understanding of the jobs that each do, but also I think it'll enhance curriculum because it will allow faculty to interact on a curriculum level.

Mrs. MORELLA. Do you do the same thing?

Dr. CLEVENDER. My particular school, I'm in Reno, Nevada. It's a very small school, or a small area, not a small school.

Mr. WALGREN. Good ski country there.

Dr. CLEVENDER. Excuse me?

Mrs. MORELLA. Good ski area.

Dr. CLEVENDER. Oh, it's wonderful.

And my relationship, at least professionally with that, is through the local section of the American Chemical Society and their seminars. Sometimes that's difficult. Their scheduling is very different from the kind of thing we do. Sixty- to 70 percent of our courses are in the evenings. I have a lot of activities like that.

We basically transfer students back and forth between those institutions very readily. It's about a 10-minute drive. In fact, I would say that the university is sometimes one of our greatest feeder institutions because the students will come from a large section and then get into our classes, which are very small. I am the same person who does the lecture and the lab.

On a national scale, the kinds of things that I see as I go around to our conferences, we try very actively to invite four-year faculty, either as presenters or to attend our local two-year college conferences. That depends on the area of the country as to how effective that is.

What I see when they come is a very intense interaction, and I would like to encourage that. They come and hear our concerns and we see some of their perspectives.

One of the difficulties with that is that the kinds of sessions that at least you get from a major university here, how do you deal with a 100-sectional lab course with TAs and that's not particularly appropriate to what we do.

I think that that exchange of that piece of information sometimes can be significant. We've actually asked to teach classes on the university campus at night, since we're short of space and they don't have many night courses. That interaction is very interesting. Obviously, that would be somewhat threatening to them.

I think that's enough.

Mrs. MORELLA. Thank you.

Dr. MENEFEE. Two specifics that I might mention; one, we're just concluding an agreement with Hood College wherein full-time students from Montgomery College could take tuition-free courses at Hood College, I think limited to two, before they matriculate to that school or elsewhere.

Another development under way at present time is program development. We're working with—through the High-Technology Council with the University of Maryland toward the development of a four-year bachelor of science and technology degree, probably in systems engineering technology, in which the community college would provide the first two years of instruction and the university would provide the second two years of instruction and the program, then, would be—it would be a shared program developed jointly wherein we do the first two, they do the second two, so a two-plus-two program that we'll put in place for the Shady Grove Center.

Mrs. MORELLA. The college is very fortunate because of its proximity to this high-tech area, High-Tech Council, and there's even an education network, isn't there, dealing with the public schools—

Dr. MENEFEE. Yes.

Mrs. MORELLA. —that may well feed into the community college, so the site is excellent and I'm glad there are such innovations. Obviously, the three of you were selected because you can exemplify the very best of what's happening in the community college level.

You have the same—you also have problems with literacy? I remember when I was here earlier that that was—

Dr. CLEVENDER. Yes, definitely.

Mrs. MORELLA. —and need some assistance with setting up the remedial programs?

Dr. CLEVENDER. At the present time, I'm now only chair of one department, rather than two. I used to be chair of Science and Math, and as of last fall, I was still chair of the Math Department. We run rooms that contain 20 to 30 students, three of those about every hour, starting at 8:00 in the morning until 10:00 at night on saturdayS, for developmental math. We still only serve about half the students that we need to put into those courses.

That is just one area as an example. Yes, that's a problem.

Dr. ALEXIOU. The college has taken the lead through the—we belong to an organization called the League for Innovation at Community Colleges. It's an organization of 16 community colleges in Canada and the United States. Miami-Dade has taken the lead in organizing that group and a couple of other schools in trying to develop computer specifications for under-prepared students. We see a crying need for using the technology that's available to deal with under-prepared students. They're in such massive numbers at our college and around the country that we can't do it with faculty on a one-on-one basis, but we can use the faculty to do what they've always done and deal with the human element and individualize the instruction with some computer equipment.

There's nothing out there that is an integrated model that we've found and we've looked all over the place to deal with all elements of writing and critical thinking and reading and mathematics. So we hosted a conference in February of 50 faculty from around the country, faculty administrators, to try to draw together those specifications that we're going to present to software developers and

hardware companies to try to get them interested in producing that material. There's a crying need around the country to deal with remediation in all those skills.

Dr. MENEFEE. I would agree. Serious national problem. We're struggling with the question of assessment of competencies, the placement of students, mandatory versus recommended placement. All of these are problems, and as we discuss them with other institutions, we find they're having the same difficulties.

Mrs. MORELLA. It seems as though the community colleges have the greatest obstacles and yet the greatest challenges and incredible opportunities at the same time.

If there were one thing that you would like us to do as members of this subcommittee, what would you say?

Dr. ALEXIOU. Can I have more than one?

[Laughter.]

Dr. MENEFEE. The one wish is that we would have 10 wishes, maybe.

[Laughter.]

Mrs. MORELLA. That's being creative.

Dr. MENEFEE. I think, speaking first, I think if there were some way that you could enhance the partnership of the two-year institutions with the National Science Foundation, if that could truly be an active, on-going participatory partnership, I think that's probably the one thing that I would like to see come out of this.

Dr. ALEXIOU. I know that's a goal of the subcommittee and the committee in these hearings, and I would—I would echo that. However, the whole question of remediation and the problems of underpreparedness of the work force and the students exiting high school and those coming back to the college is so overwhelming that I think it's on the verge of a national security crisis, and I think we need to deal with it, looking at it in those terms.

It seems to me it's not something that can be dealt with institution by institution or even State by State, but it needs some sort of national policy, at least to look at the issue and try to arrive at some consensus of how to approach it.

Dr. CLEVENDER. I think there need to be—you go through this at National Science Foundation and I say that because I've dealt with them and also because they are recognized within the science community so they probably are the appropriate agency—specific national programs targeted at two-year colleges. When they speak, others listen. I think that specific direction to say, we think they're important; this is what we want; this is how we're going to do it—some of that's occurred in the K through 12. I think a similar national prestigious program for two-year schools, not necessarily as a set-aside, something that could be done, but we are interested. We want them.

That will then call other funding agencies, other sources, to that target.

Mrs. MORELLA. I thank you. I just wanted you to know that note who's been the chairman pro temp. This shows the kind of subcommittee this is, when the—how democratic it is, with a small "d," when a member of the minority party can be the chairman for a bit.

Mr. Chairman, I thank you for the opportunity. It's been an excellent panel and I did suggest that our subcommittee might well submit some recommendations and questions to the National Science Foundation with regard to the role of the two-year college, and I thank you.

Mr. WALGREN. Well, thank you very much, Mrs. Morella.

I don't think anyone can add to the things that you've just said in—in response to Mrs. Morella and I think they should be left to stand brightly at the end of this hearing. It makes you want to take the last page of the transcript and rip it out and send it to the souls down there and see how we can urge them on.

That's the position that we're in and you've helped us along that way very nicely. I appreciate your—your having been a resource to us.

[Whereupon, at 4:55 p.m., the subcommittee was adjourned, to reconvene subject to the call of the Chair.]

APPENDIX

Joint Commission
On Federal Relations

April 21, 1989

The Honorable Doug Walgren
U.S. House of Representatives
2241 Rayburn House Office Building
Washington, D.C. 20515

Dear Doug,

While your April 11 hearing on community colleges and the National Science Foundation may not have met all your expectations, I felt strongly that the outcomes were largely positive. Your colleagues on both sides of the Subcommittee showed in force over the course of the hearing that they share your concerns with NSF, and you must have found this heartening.

If the hearing record is still open, I hope you will permit me to add some observations for the record.

Education has never been so much at the crux of the global challenges facing our country as it is today. Its importance to both national security and economic, scientific, and technological competitiveness is beyond dispute. As Senator Paul Simon remarks so often, "We build the future through education."

Every educational system and institution, like every State, must now view its programs from the perspective of global competition. And invariably that perspective turns on the quality of the workforce.

Given the steady "downward slide" of the American economy in global terms you spoke of at our AACJC convention, the weakened state undergraduate science education, in comparative terms, points up a serious gap in national policy: a gap most logically addressed, we believe, by your bill, your Committee, and the National Science Foundation.

Your bill holds the best answer yet devised to the question on which you opened the hearing — the "competing" demands on the community college mission. Your bill would help ensure that these demands — programs that fill immediate skill needs in the community versus technician training of greater depth in science and technology — become entirely complementary to each other, to the long term benefit of both American science and the workforce.

The partnerships your bill would engender would unleash untold resources in both "cutting edge" equipment and technology and instructional talent to both community colleges and state colleges, and to the nearly 80 percent of all college

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freshmen and sophomores these colleges serve. These partnerships between employer and campus can be generated with only a tiny fraction of the federal funding flowing through NSF.

It was a breakthrough in our view to hear Dr. Watson's testimony for NSF observe that "The NSF clearly has the legislative charter to address the needs outlined in the proposed bill." Compatibility with the NSF mission obviously is not an issue. Why the NSF shows no enthusiasm for this challenge is beyond our comprehension. If its leadership thinks that scientific discovery alone will keep America in the forefront of global competition, then it is blind to the "downward slide" -- and blind as well to the great demographic shifts that now fill the mainstream of the nation's future talent.

The NSF's attitude seemed best characterized in Congressman Boehlert's opening remarks when he said "community colleges are really the Cinderellas of our educational system. Treated like inadequate stepsisters by the rest of the higher education family, two-year schools have been too often banished to the shadows where policymakers are unlikely to find them." Equally insightful was his conclusion that "the federal government needs to do more for community colleges, and NSF must ensure that community colleges take full advantage of its programs."

In this light, we find it hard to see President Kraft's recommendation to the Committee as anything but equitable and reasonable -- namely, that if NSF funding is doubled over the next five years, as President Bush and others have urged, then half of that net growth in funding be earmarked for undergraduate science programs, to increase both the quality and access of the math and science programs for freshmen and sophomores whose career decisions well may turn on that quality and access. We again urge your support for this recommendation.

We hope you and the full Committee are still considering a hearing in May to expand upon the beginnings you made in your April hearing. With a bit more lead time, I know we can deliver fuller panels of expert witnesses, fully versed in what is at stake for the nation's competitive future in the quality of its science initiatives for lower-division college students.

We thank you again for your vision and persistence. Your leadership already has added a new edge to the mission of community colleges. Meantime, community colleges will redouble their efforts to build House and Senate sponsorship for your bill. Warmest regards.

Sincerely,

Frank

Frank Mensel
Vice President for Federal Relations, AACJC
Director of Federal Relations, ACCT

FM:egd

cc: President John Kraft
President Cary Israel
Congressman Boehlert
Dr. Robert Watson
Joint Commission Members

Community College
of Allegheny County

CCAC

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PRESIDENT
JOHN W. KRAFT

April 24, 1989

The Honorable Doug Walgren, Chair
Subcommittee on Science, Research and Technology
U.S. House of Representatives
2319 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Chairman:

Thank you again for the April 11 hearing, and for your tireless efforts to make improvements in undergraduate, lower division science and mathematics programs a higher priority with the National Science Foundation. It was most encouraging to see how widely your concerns are now shared on both sides of the Committee. In light of questions raised during the hearing, we would like to elaborate on several points for the hearing record while the record is still open.

Your opening question of the hearing about the dual demand on community colleges -- programs that fill immediate skills needs versus programs that provide technicians and transfer students with more depth in math and science -- deserves a fuller answer. It goes to the very heart of the issues -- i.e., the priorities that your Committee may set for the National Science Foundation.

Admittedly, community colleges are struggling in many instances to fill both needs with quality programs. In some cases perhaps, one demand may be satisfied to some degree at the expense of the other. Ideally, however, community colleges see the two as complementary, not competing, demands.

The beauty of your bill, Mr. Chairman, is that it would strengthen higher education in serving both demands. And, in the end, it would increase substantially the stream of community college graduates and transfer students who continue as science majors at senior colleges and universities and eventually move into graduate programs.

ALLEGHENY CAMPUS
808 Ridge Avenue
Pittsburgh, PA 15212-6097

BOYCE CAMPUS
595 Beatty Road
Monroeville, PA 15146-2174

CENTER-NORTH
1130 Perry Highway
Pittsburgh, PA 15237-1398

SOUTH CAMPUS
1750 Clairton Road, Rt. 885
West Mifflin, PA 15122-3097

While the partnerships that you would foster between high-tech employers and community colleges would bolster both the quality and delivery of programs that fill critical skills, it would also enhance the college's access to both state-of-the-art equipment and science instructional resources -- i.e., scientists and engineers from industry who are on the cutting edge of technological change.

Such resources would at the same time enrich the academic programs, giving greater quality and scope to course offerings in science and math.

The larger higher education community, the scientific community, the employer community and the general workforce would all benefit.

It is unfortunate that the NSF cannot see how much your legislation would strengthen its mission, and how it would brighten America's chances of building the world-class workforce the nation must have to maintain its scientific leadership.

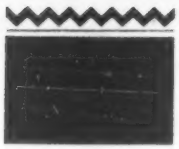
Thank you again for your persistence and vision. You can be sure that the community colleges are going all out to help you build broad cosponsorship for your bill.

Sincerely,

John W. Kraft
President

/kaw

Advancing the Public/Private Partnership



Advancing the Public/Private Partnership

Montgomery College
1988
Report to the Community

Photograph by Barbara Borkovitz

Meeting the needs of the corporate, business and governmental communities is a significant priority for Montgomery College. More than a thousand Montgomery County employees, for example, participate annually in job-related courses provided by the College at their work sites. One- and two-year technical programs at Montgomery College are designed in response to specific employer requirements. Advisory committees of employer representatives provide leadership and guidance to each technical program.

Montgomery College has demonstrated its commitment to education and training for the private sector, and I have chosen to focus my annual report on this aspect of our mission since I believe the

College's efforts in these areas are not widely understood. Future reports will deal with other aspects of our mission such as providing the first two years of baccalaureate degree preparation.

We at Montgomery College believe in the development of the whole person whether preparing students for transfer to a four-year college or for direct career entry. We feel it is important that a graduate of a printing management program, for example, knows how to read, write, communicate effectively, think logically and solve problems in addition to running printing presses. That belief extends to those planning to earn a four-year degree as well as those seeking technical education.

The College, in partnership with the public and private sector, plays an active role in the economic development initiatives of Montgomery County by providing individuals with technical skills. By providing a broad liberal education as well, we prepare these same individuals for an ever-changing world and help them to be prepared to make adjustments when technological requirements change in their chosen career field.

Highlighting the College's contribution to the county's economic health is the fact that 90 percent of our graduates are employed in Montgomery County and the D.C. metropolitan area. Significant numbers of four-year college and university graduates leave the state for other areas of the country. Our graduates tend to remain in this community as productive employees who make substantial contributions to the local tax base.

We anticipate the development of even stronger relationships with the government and corporate communities in coming years and will continue to provide educational services to them.

As President of the College, I encourage those of you in business and government to take advantage of these opportunities and to let me know when you have additional needs.

Sincerely,

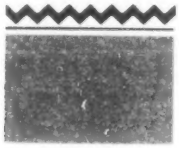
Robert E. Parilla
President

"I think the faculty at Montgomery College are there to teach. It's the finest teaching I've ever had at the college level, and I've studied in several institutions. The emphasis is right where it belongs—on teaching."

HILDE ALTER

Left to right, Patricia Bissell of Keller, Zanger, Bissell and Co. and Ms. Alter.

The College's campuses in Germantown, Rockville and Takoma Park and the Continuing Education division are committed to meeting the needs of businesses and government whenever those needs fall within the College's mission.
In the following pages, you will learn about our educational programs and services through the success stories of some of the people Montgomery College has served.



Direct Career Preparation

Hilde Alter earned a bachelor's degree in English and history from The American University in 1966 and began teaching for the Easter Seals organization. She had started a master's degree in physics, even though she knew jobs in physics were not plentiful. She decided to visit Montgomery College during winter registration in 1976 and discuss some career options. The first desk she came to was accounting, and although she had never studied business, she decided to try one course. She knew immediately that accounting was for her.

Ultimately, she completed 30 credits in accounting and six credits in business law at Montgomery College. Because she already had earned a bachelor's degree, she was qualified to sit for the CPA exam in Maryland.

Prior to sitting for her examination, Ms. Alter was hired by the Bethesda firm of Regardie, Brooks and Lewis. After passing the exam, she opted for part-time employment and was hired by Bissell, Associates and Co. in Rockville. Today, she has been with Keller, Zanger, Bissell and Co. full-time for ten years and is a partner in the firm.

Ms. Alter was the first Montgomery College alumna hired by the firm. Since then, "I've hired eight Montgomery College alumni," says Patricia Bissell, partner, "and I would hire even more."

Ms. Bissell echoes the sentiments expressed in a 1987 survey of employers of 1984 Montgomery College graduates. Virtually 100 per-

cent of the respondents said they would hire an MC graduate again, and they expressed high satisfaction with the educational preparation of their employees. In addition to satisfaction with their employees' performance of job tasks, the employers gave high marks to three other specific areas: the ability to learn, the ability to communicate and the ability to work well with others. The survey results are an excellent reflection of the success of the College's strong belief in combining a comprehensive general education with technical training to prepare students for direct job entry.

What makes the College's program so special? Perhaps Hilde Alter expresses it best:

"I think the faculty at Montgomery College are there to teach. It's the finest teaching I've ever had at the college level, and I've studied in several institutions. The emphasis is right where it belongs—on teaching."

Ms. Bissell's association with the College has been so beneficial to her firm that she has chosen to return that support in a variety of ways. She is currently chairperson of the Montgomery College Foundation, a nonprofit corporation that seeks private sector support for College programs.

She also represents her firm as a member of the President's Forum, a group of business leaders and financial supporters of the College who serve as advisers to the President. She has been a member of the College's accounting advisory committee, and she has been instrumental in the development of the College's accounting curriculum.

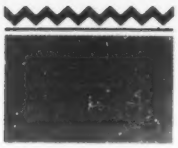
Ms. Alter is an example of the many students who enroll in Montgomery College technical and career programs to prepare them to enter the work force immediately or to change careers or update skills.

In addition to the accounting curriculum Ms. Alter chose, other categories of career programs include art and advertising art, aging and disability, applied technologies, communication and broadcasting technology, computer science and technology, criminal justice technology, education technology, electromechanical systems/engineering technologies, fire science, geography/cartography/community planning, hospitality management, landscape technology, legal assistant, management technologies, medical/health technologies, office technology, photography and printing management.

These programs are intended primarily for students planning career entry immediately after graduation, but they also provide for transfer to four-year programs in related areas.

"All the faculty are first class. Montgomery College served as a base for my education. It's a tough school with high standards, an excellent school."

PEPE MONTESINOS
Enriqueta's



Transfer Education

Not all students who plan to earn a bachelor's degree begin their education at a four-year college or university.

When Pepe Montesinos came to this country from Mexico, he wanted to be a pilot. He discovered, however, that because of his age and limited English skills, he could not qualify for an appointment to the Air Force Academy. Because he knew he needed an education, he first entered a language institute and eventually came to Montgomery College.

Now the owner of three successful restaurants—Enriqueta's of Georgetown, Enriqueta's of Adams Morgan and Mixtec in Adams Morgan—Montesinos began classes at the Takoma Park campus in 1970. He completed his coursework in business administration and transferred to Salisbury State where he earned a bachelor's degree in business and economics. Montesinos currently is working on a master's degree in marketing at Southeastern University in Washington.

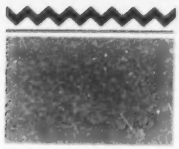
Montesinos attributes much of his success to the education he gained at Montgomery College. "All the faculty are first class. Montgomery College served as a base for my education. It's a tough school with high standards, an excellent school."

Pepe Montesinos is an example of the many former Montgomery College students who have transferred to a four-year college or university and earned a bachelor's degree. Many have gone on to earn graduate degrees.

Research indicates that Montgomery College students who transfer to four-year institutions do as well as those students who begin their education at four-year institutions. Since Montgomery College is an open admissions institution and many four-year colleges use selective admissions criteria, the success of our transfer students is measurable testimony to the College's effectiveness.

"In the next couple of years, we expect to offer our employees eight to ten courses through Montgomery College and then repeat the cycle."

JAMES T. DOUGLAS
Marriott Corporation



Off-Campus Credit Offerings

Montgomery College began offering credit courses throughout the community in the early 1970s in response to employers' requests for educational opportunities at their work sites. Locations included the National Naval Medical Center in Bethesda, Health and Human Services in Rockville and the National Bureau of Standards in Gaithersburg.

Additional off-campus courses were made available in local schools including Good Counsel High School in Wheaton and E. Brooke Lee Intermediate School in Silver Spring. The school sites, not connected with an employer but serving as convenient community facilities, attracted many local residents who began taking courses near their homes rather than on a Montgomery College campus. Many of these students later enrolled at one of the College's three campuses for additional study.

By fall 1987, off-campus sites were enrolling approximately 700 students per semester. Courses ranged from techniques of reading and writing and general psychology to technical writing, real estate practice and brokerage, and introduction to computer applications.

The Marriott Corporation began offering credit courses to its employees after successfully using the College's contract training services. James T. Douglas, manager of human resource development for the architecture and construction division, says the College originally came to Marriott with continuing education noncredit courses. Expansion into credit courses followed naturally.

"When I was employed at ConEdison in New York," Douglas said, "we brought in a community college to provide courses for our employees on site. When I came to Marriott, it seemed logical to bring an institution to the Marriott Headquarters to make it easier for employees to take classes.

"One of our departments wanted to help employees become more attuned to a business environment, so we asked Montgomery College to offer courses right here. We began by having the College teach business law and business management. In the fall, we plan to offer accounting.

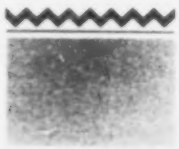
"In the next couple of years, we expect to offer our employees eight to ten courses through Montgomery College and then repeat the cycle."

Currently, the College also offers courses at Fairchild Space Company and Bechtel Power Corporation, both in Germantown; AT&T in Silver Spring; Health and Human Services and Computer Data Systems, Inc., both in Rockville; Walter Johnson High School, Defense Mapping Agency and Naval Medical Command, all in Bethesda. Two new sites, the National Institutes of Health in Bethesda and John F. Kennedy High School in Silver Spring, will be added this fall.

One of the most recent partnerships with the business community and off-campus credit stems from the regulations associated with the food service industry.

Officials from the Holiday Inn in Bethesda and the Marriott in Gaithersburg have contracted with the College to offer their employees a course in food service sanitation. Following that lead, in spring 1988, several individual restaurants banded together to offer the same course to their staffs through the College.

The off-campus credit program continues to serve the needs of local businesses and government by expanding campus boundaries and providing accessible courses for employee training, upward mobility and professional development.



Job Training Partnership Act

A 36-year-old single parent, Barbara Conelley had been employed for the past 12 years in a field she enjoyed, but she suddenly found herself unable to work. She tells her own story:

"My career as a cabinetmaker came to an abrupt end when I injured my back in a freak accident. My doctors said I'd never have the strength or the stamina to resume my former life. What to do? I considered a number of options—including giving up altogether—and then I got serious.

"I'd always wanted to be an architect, and I figured I could put my mind instead of my back toward that goal. Again How to reach

that goal? Studying architecture takes a great deal of money, and my days as a wage earner had ended, at least temporarily.

"As a single parent with the responsibility for a 17-year-old son, I needed some kind of training, some kind of skill that could be of primary assistance in my long-range planning and at the same time help me on my way financially.

"It occurred to me that if I could qualify for a job in a construction office or an architectural firm, I might be able to convince the firm to pay for my continuing education. When I saw the flyer for the accelerated word processing program, I knew I had found the answer. The Department of Social Services steered me to the JTPA office on the Montgomery College campus, and I was able to qualify for financial assistance."

The program Barbara Conelley selected is offered cooperatively with the Rockville campus and the Office of Continuing Education. Students in the program are able to complete an entire word processing certificate program in the period of one semester. They may choose to earn college credit or enroll for no credit.

Conelley is the first JTPA client to receive funds for the program. Her situation fits the classic JTPA profile. To qualify for JTPA's employment and training services, an individual must be economically disadvantaged, handicapped or have serious barriers to employment and be a resident of Montgomery County.

Established by the Job Training Partnership Act of 1982, the Montgomery County JTPA operation has been under the guidance of the Montgomery County Private Industry Council since October of 1983 and administered by Montgomery College since June 1984.

Through its Beginnings program, JTPA offers comprehensive skills assessment and career counseling leading to placement in the classroom or on-the-job training in a variety of occupations.

A number of businesses throughout the county are beginning to request temporary and part-time employees through the on-the-job training program, and some of those employees are being hired on a permanent full-time basis when their training assignment ends.

A corollary program—New Horizons—provides resumé writing, interviewing and other job placement skills to JTPA clients.

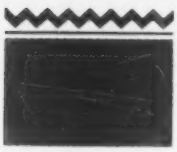
Young people in the Montgomery County Conservation Corps, also administered by Montgomery College, are eligible for JTPA assistance through GED testing, New Horizons and college classes.

Approximately 300 Montgomery County citizens are served each year through JTPA. The end result of the county, state and federally funded program? Self-sufficient, productive citizens.

"When I saw the flyer for the accelerated word processing program, I knew I had found the answer. The Department of Social Services steered me to the JTPA office on the Montgomery College campus, and I was able to qualify for financial aid."
BARBARA CONELLEY
Accelerated Word Processing Program/JTPA

"Montgomery College is one of the finest community colleges in the United States, and it's recognized for its innovative and responsive attitude toward working with the business community."

WALTER PLOSILA
Montgomery County
High Technology
Council



Contract Training

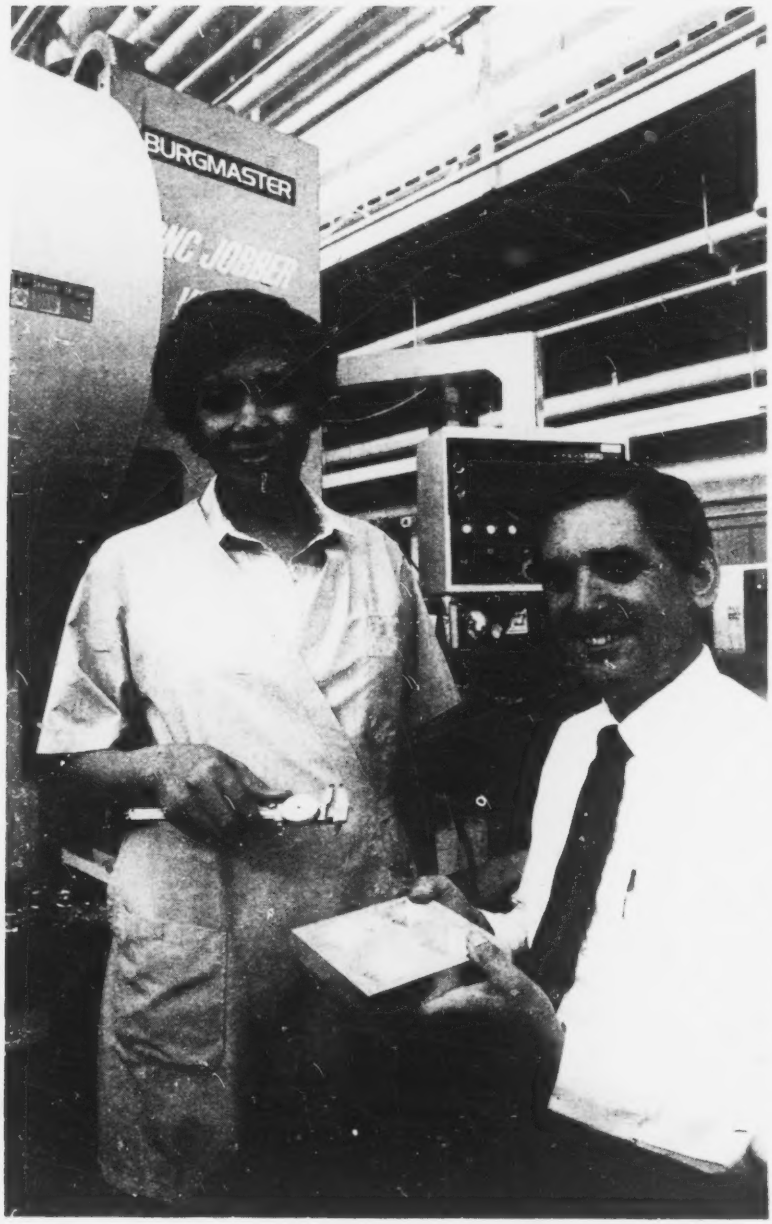
The healthy economic growth Montgomery County has experienced in recent years has changed the perception that the county is primarily a bedroom community for the federal government. The number of Montgomery Countians who live and work in the county is increasing rapidly. Recognizing this fact, Montgomery College has played a major role in addressing the staffing needs of business and governmental organizations.

Advances in technology and organizational operations require on-site training to upgrade employee skills for new and previously existing institutions and firms. In the five years since the Montgomery College Office of Continuing Education first began offering this kind of training, more than 100 organizations have taken advantage of it by contracting with the College. Subjects studied by employees have ranged from integrated circuit board assembly to supervisory management techniques. Nowhere is the role of contract training more significant than in high technology.

Walter Plosila, president of the Montgomery County High Technology Council, says "Montgomery College is one of the finest community colleges in the United States, and it's recognized for its innovative and responsive attitude toward working with the business community. The College plays an active role in the efforts of the High Technology Council, helping not only to design courses and curricula to meet the needs of high tech firms but to deliver them in ways that best serve the needs of the high technology community here."

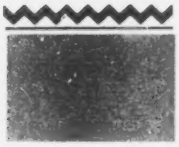
A recent series of focus groups conducted by the High Technology Council has helped the College identify four specific areas for further development: management and supervisory training, technical training and skills development, electronics and biotechnology laboratory technician training.

In addition, the College, in cooperation with other Maryland community colleges, the State Department of Economic and Employee Development, local economic development offices and the State Board for Community Colleges, will launch a statewide economic development promotional campaign this summer to further highlight opportunities for the surrounding business and governmental communities.



"We provide the hands-on training for our employees, and the College provides the academic background."

JOHN HENNINGER
Left to right,
Marva Johnson,
Apprentice, and
Henninger
Goddard Space
Flight Center



Apprenticeship

Staffing for the National Aeronautics and Space Administration's Goddard Space Flight Center posed a considerable problem in the late 70s.

Historically, NASA had recruited machinists from the armed services, but the pool was beginning to dry up. Skilled employees were nearing retirement, and there was no clear way to fill available positions with highly trained personnel.

In 1977, Goddard officials approached Montgomery College after exploring other options within the metropolitan area. Their visit was the beginning of the apprenticeship/journeyworker training program.

John Henninger, Goddard section head for electroplating and plastics model building and chairman of the technician apprenticeship program, notes the importance of the training effort.

"We needed machinists, spacecraft assemblers and other highly technical personnel, and Montgomery College more than helped us meet those needs. As a result, we've built an important partnership with Montgomery College.

"We provide the hands-on training for our employees, and the College provides the academic background. Our employees are paid for a typical 40-hour work week; they spend four days at Goddard and one day in the College program. About ten people are in the last year of their four-year program right now."

Other employers were experiencing similar problems in finding qualified employees for trades. Stanley Allen, recently retired from the National Institutes of Health after 33 years, says the need for a systematic approach to this specialized kind of training was identified in the 1960s.

It became increasingly clear that for NIH, it was preferable to train the trades employees directly. Employees in dead-end jobs or those who wanted to change their career path could enter the apprentice program and increase their skill and salary level. They found that the apprentice program could be a useful tool in upward mobility as well.

Allen, who was chief of the shops branch and chairman of the NIH Apprenticeship Committee, notes that Goddard, NIH and the National Bureau of Standards were the first agencies involved in

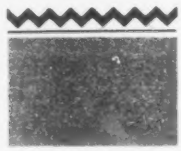
establishing the Montgomery College apprenticeship-related instruction program.

The program was developed jointly by shop managers, the Maryland Apprenticeship and Training Council and the USDL Bureau of Apprenticeship and Training.

Employer sponsored, the program includes the following trade areas: air conditioning/refrigeration, boiler operation, carpentry, electricity, electronics, elevator mechanics, machine shop, masonry, painting, plumbing/pipefitting, precision sheetmetal, sheetmetal and utility systems repair.

In 1985, after the apprenticeship program was well underway, the Office of Continuing Education sponsored a conference to determine the staffing needs of major local employers in both the private and federal sector, including organizations such as COMSAT, Fairchild Space Company, Washington Adventist Hospital and the Montgomery County government.

A natural result of the workshop was the development of journeyworker training. Another important outcome of the conference was establishment of the apprenticeship-technical training advisory committee. According to Allen, the committee offers the training programs a voice within the College. The College, in conjunction with county employers, plans another conference in the fall to address the shortage of trained technicians.



Center for Small Business

With the failure rate of small businesses hovering around 50 percent within the first five years of operation, many organizations find a need for both initial and ongoing professional assistance.

When Wolfgang and Elizabeth Esch formed their own company in 1986, they got in touch with the Montgomery College Center for

"Our whole interaction with the center has been integral to our success."

ELIZABETH ESCH
Left to right,
Ms. Esch and
Wolfgang Esch
Capital Presentation
Services

Small Business. They had studied market trends in microcomputer graphics and decided to begin their own firm.

"We thought we had the capability to create a successful business, and we wanted to do it," says Ms. Esch. "You can be experts in a field, but that doesn't mean you know about marketing, finance, legal issues, taxes, etc."

The Esches first spoke with Janice Carmichael, director of the Center for Small Business. She put them in touch with Nelson Hoy, a volunteer business consultant at the center, who helped them develop their business plan for Capital Presentation Services, a highly successful visual presentations and computer graphics company.

Two years later, the Esches' firm was the focus of a small business forum. More than 100 individuals attended and a panel of four experts critiqued their progress to date, in some instances offering suggestions for change.

In assessing the experience with the Center for Small Business, Ms. Esch says, "Our whole interaction with the center has been integral to our success." The Esches now share their professional expertise with others by teaching courses in visual presentations for Continuing Education.

The Center for Small Business, located in Bethesda, began operating in 1985.

Specialized services include:

One-on-one business counseling, offered on a long- or short-term basis for problem-solving, intervention or assistance with business start-up procedures. Help for individuals in writing a business plan for operation as well as assistance for businesses attempting to seek federal contracts are available.

Seminars and workshops. Topics include presenting your company's story in the media, a generic program on computer acquisition for a business and how to obtain financial resources.

Short-term courses described in *The Best for Business.* This free publication is mailed to 27,000 organizations. Two of the courses, pre-business planning I and II, are recommended before entering the business counseling phase.

The center benefits the community directly by bringing together experts in business with individuals and organizations seeking to build successful enterprises. The experts include volunteers from the Service Corps of Retired Executives (SCORE) and private consultants.

Training and Development Services Program

Montgomery College entered into a contract with NIH in 1984 to develop a training program to provide both college credit and transferable job skills for the employees at the National Institutes of Health in Bethesda. The contract is presently being renewed for another year with an option to extend for five years.

TDSP provides participants with skill diagnostic testing in English, verbal ability, reading, spelling and math. After interpretation of the test results, the employee is advised to enroll in certain courses.

Project Director Mary Kay Galotto has been with the program since 1984. She says, "TDSP provides a marvelous opportunity for motivated NIH employees to obtain career direction while earning college credits. It's an inspired example of what can be achieved through a partnership between the College and caring, intelligent management."

Community Research Service

One of the best examples of Montgomery College's expanding involvement with public and private sector employers is the Community Research Service. Provided through the Office of Continuing Education and directed by Dr. Michael Fischetti, it links county organizations who need top-level, short-term consultants with Montgomery College faculty and staff who can assist in meeting those needs.

The service offers survey and questionnaire development and management; research design; statistical analysis; demographic, evaluation and feasibility studies; needs assessment; writing and report design, and video technology. Marketing techniques also are available.

Within the last two years, the service has assisted several governmental agencies, including Housing and Community Development, Department of Transportation, County Health Department and others. A needs assessment for the American Red Cross also was conducted in 1987 with funds from the Sears Foundation.

Director Fischetti says, "The nominal fees charged for using the service allow it to be self-supporting and extremely helpful to the local community."

New Facilities

The College must have adequate facilities and equipment to meet the educational needs of the corporate, business and governmental sectors.

To assure the progressive enhancement of career and technical training, the College has taken steps to provide facilities for new and growing programs. At Rockville, an interim technical training facility was opened this spring. A permanent facility to house the automotive and printing programs as well as certain facets of the apprenticeship and contract training programs is in the planning stage.

In 1988, major renovation at the Rockville campus has included the conversion of the old administration building to the counseling and advising building. Also scheduled are alterations and improvements to the existing technical building.

At Takoma Park, plans are underway for improvements to the computer labs to increase student access in light of changes in computer technology.

For Germantown, specifications are being written for a fourth building to house new programs, many of which are in high technology.

The planning has involved the College facilities office, the campuses and the curriculum advisory committees. The advisory committees are made up of employer representatives who volunteer to provide leadership and guidance to each of the College's technical programs. The College's partnerships with its advisory committees guarantee that programs are offered in an up-to-date setting with state-of-the-art equipment.

Fiscal Information

The College's ability to respond to private sector and individual education and training needs is made possible by the financial support it receives from a variety of sources.

The Montgomery County government provides approximately 47 percent of the $49 million of operating monies required for a fiscal year. Funds from the State of Maryland are apportioned based in large part on student enrollment. The money allocated by the state accounts for about 21 percent of the budget.

Most of the remaining funds are obtained through tuition and fees charged to students. In many cases, individual employers pay tuition costs for employees who enroll in job-related courses.

Montgomery College and its Board of Trustees have a strong commitment to maintain a reasonable level of tuition. This commitment is in keeping with the community college mission to ensure financial access to all students.

In order to enhance the quality of Montgomery College beyond the level that governmental assistance permits, the Montgomery College Foundation was formed in 1982 to seek private sector support for the College. The corporate, community and alumni leaders who have been instrumental in the Foundation's work have assisted in raising about $150,000 during fiscal year 1986–87.

Foundation funds are used to provide scholarships to academically excellent or economically disadvantaged students, to help meet the start-up costs associated with new programs and to help purchase the costly equipment often necessary to assure adequate education in highly technical fields. The funds also support faculty development activities.

In the last three years, financial support from alumni of Montgomery College has shown dramatic growth. College graduates and former students now give approximately $40,000 to the Foundation each year. Their gifts have endowed scholarships and supported faculty enrichment programs, athletics and innovative instructional projects.

Alumni contributions are not just financial, though. Alumni participate in curriculum advisory committees, are members of the Board of Trustees, assist in obtaining needed political support and provide other types of voluntary service.

In addition, some alumni have joined with other corporate leaders to form the President's Forum, an organization now numbering 42. Forum members support the College through direct and indirect gifts and through serving as special advisers to the President. The time and expertise contributed by Forum members, advisory committee members and others are assets that benefit Montgomery College daily.

In Summary

Montgomery College continues to make a significant investment in its community by providing exceptional resources to individuals and organizations in business and government.

As this report shows, those resources include credit and noncredit courses on the College's three campuses as well as at a number of off-campus sites throughout the county. The College provides contract training and job-related courses at the work site and both technical and career programs for the student who wants to enter the work force right away, change career direction or simply update skills.

Most importantly, the College is interested in educating the whole person whether that person is interested in a technical program, transfer to a four-year institution or taking a single course. The College further assures that a broad-based general education background is provided to graduates of both technical and transfer programs.

If you have educational needs we can help you with, let us know. If you desire further information about Montgomery College programs and services, please contact us. We will continue to make every effort to meet your educational needs. We're serious about our commitment to this community, its individuals and its organizations.

For more information about programs described in this report, please call:

GERMANTOWN CAMPUS	972-2000
ROCKVILLE CAMPUS	279-5000
TAKOMA PARK CAMPUS	587-4090
CONTINUING EDUCATION	279-5188
CENTER FOR SMALL BUSINESS	656-7482
CONTRACT TRAINING	279-5228
TDSP (National Institutes of Health)	279-5236
EXTENDED LEARNING (Off-Campus Credit Program)	279-5254
COMMUNITY RESEARCH SERVICE	279-5188
JOB TRAINING PARTNERSHIP ACT	279-2046
CONSERVATION CORPS	294-8720
APPRENTICESHIP	762-8454

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For information about Montgomery College, its campuses or its programs, please write to:

Montgomery College
Office of College Relations
900 Hungerford Drive
Rockville, MD 20850

or telephone: (301) 279-5310

Produced by the Office of College Relations, Max Schaible, *Director*
Text, Paula Matuskey/Editing, Max Schaible/Coordination, Amy Moorer
Design, Jane Knaus/Photography, Linda Bartlett
Research, Office of Planning and Institutional Research

ON THE COVER: Barbara Conelley, a student in the Accelerated Word Processing Program, works out a problem with her professor, Patricia Ryan. Photograph by Linda Bartlett.

Montgomery College is an equal opportunity and an affirmative action institution.

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JUNE 1988

CRITICAL ISSUES
IN TWO-YEAR
COLLEGE CHEMISTRY
ORT WITH RECOMMENDATIONS

CRITICAL ISSUES IN TWO-YEAR COLLEGE CHEMISTRY

REPORT WITH RECOMMENDATIONS

Report of the 1985 Invitational Education Conference Sponsored by the Society Committee on Education of the American Chemical Society

Chevy Chase, Maryland
November 15–17, 1985

CONTENTS

Introduction 2
Recommendations 3
To the National Science Board 4
To the American Chemical Society Committee on Education 6
To the Governing Bodies of the American Chemical Society 9
To the Colleges 10
To Other Professional Organizations 11
Participants 12

The Two-Year College Chemistry Conference of the Division of Chemical Education, Inc. *generously provided partial financial support for the Conference and the distribution of this report.*

COVER—NORTHERN VIRGINIA COMMUNITY COLLEGE – ALEXANDRIA CAMPUS, J. PICKERELL

Introduction

The American Chemical Society Committee on Education periodically brings together recognized authorities in science education to discuss contemporary issues and to recommend future directions for the Society's endeavors. In November of 1985, 43 invited conferees met in Chevy Chase, Maryland, to identify critical issues in two-year college chemistry education, and to make recommendations to the agencies capable of addressing these issues.

The Participants

The individuals invited to the conference were selected to bring many years of diverse experience to the conference deliberations. The size, scope, and complexity of the issues necessitated bringing together delegates from every conceivable sector of two-year college science education. The two-year college chemistry teachers were joined by two-year college physics and biology teachers (representing their professional associations); four-year college chemistry teachers; part-time teachers; two-year college administrators (including a college president, a member of a board of trustees, a divisional dean, and a member of a state board for community college education); and representatives from teachers' unions, federal funding agencies, regional accrediting bodies, professional associations, and the chemical industry. The list of participants appears at the end of this report.

Two-Year Colleges Today—Connie Sutton-Odems
Two-Year College Chemistry Students—Lucy Pryde
Two-Year College Chemistry Faculty—Tamar Susskind
Curricular Trends in Two-Year Colleges—William Mooney
Chemical Technology Programs—Harry Hajian
Teaching Chemistry in Two-Year Colleges—Doris Kolb
Curricular Guidelines for Chemistry—Donald Jones
Using Consultants for Program Development—William Cook
Administrative and Financial Support—Edmund Bradford
Articulation among Colleges—Jeff Davis
National Science Foundation Perspectives—Robert Watson
Regional Accreditation Programs—Robert Swenson

Figure 1. Papers presented at the conference.

The Program

The Society Committee on Education Task Force on ACS Involvement in the Two-Year Colleges organized the conference around 12 topics (see Figure 1). The Task Force also selected an expert in each topic and invited those persons to prepare a paper for presentation at the conference.

Following presentation of the papers, the participants separated into eight topical discussion groups to consider the information that had been presented. Each topical group (see Figure 2) developed a list of recommendations that addressed the issues raised during their deliberations. All conference participants met together on the final day of the meeting to discuss the eight lists of recommendations.

The lists of recommendations were eventually combined with several other recommendations received from individuals, sorted according to the group or body charged with implementation, and redistributed to the conference participants who assigned a priority rating to each recommendation. The recommendations that follow in this report are organized by groups, according to the implementation body. Within each group, the recommendations follow the order of priority assigned by the conferees.

It was apparent at the close of the conference that a great deal needs to be done to help two-year colleges meet the challenges of their expanding role in modern chemistry education. Much of the responsibility for these needed efforts falls squarely upon the shoulders of the faculty, administrators, and local governing boards of individual community colleges. The governing bodies for higher education in the states, too, must facilitate these efforts by encouraging and supporting improvements.

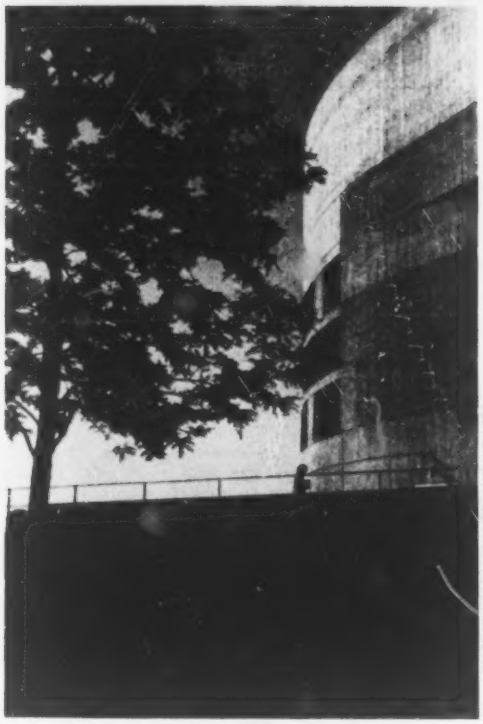
A great many of the issues raised during the conference are global in nature and can be addressed only by groups with nationwide influence. However, the American Chemical Society and the National Science Foundation can only establish programs, they cannot implement them. Unless individuals at the state and local levels take an active role in implementing these programs, there will be no improvement in two-year college science education.

Chemistry Courses for Science and Engineering Programs
Chemical Technology Programs
Chemistry Courses for Other Programs
Chemistry Faculty Issues
Financial Support for Programs
Industrial Articulation and Support
Four-Year College Articulation
Instruments and Computers

Figure 2. The discussion groups

Recommendations of the 1985 Invitational Education Conference of the American Chemical Society:

ACS PHOTO, C. BORGFORD



COMMUNITY COLLEGE OF RHODE ISLAND—KNIGHT CAMPUS

Copies of the presented papers as well as communications from participants and other interested individuals are available at no cost. Write: Two-Year Colleges Program, American Chemical Society, 1155 Sixteenth Street, N.W., Washington, DC 20036.

To the National Science Board

Two-year colleges constitute a significant segment of, and make a major contribution to, undergraduate science and engineering education in the United States. The magnitude of this contribution is reflected in the fact that two-year colleges presently enroll 41% of all undergraduate *credit* students, 55% of all first-time college freshmen, and more than 50% of all minority students.

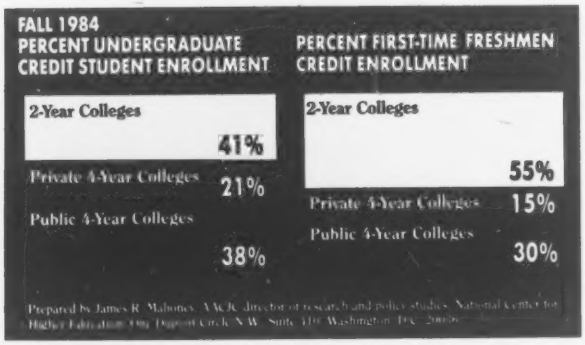
Modern, comprehensive community colleges, regardless of their varied histories and public images, are today providing the first two years of postsecondary education for substantial numbers of students who eventually receive a baccalaureate degree. These graduates are the nation's next generation of scientists, engineers, and teachers. It cannot be in the country's best interest to neglect the all-important first years of their college education.

Three very serious problems undermine the ability of two-year college chemistry departments to fulfill their role as providers of high-quality science education for both transfer and technical students. These colleges:

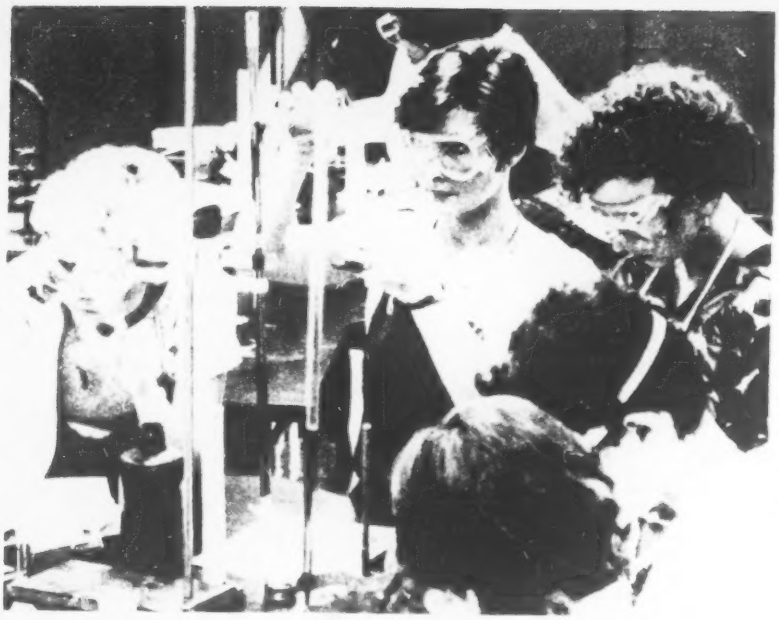
1. Are frequently staffed with overworked faculty who have few resources for professional growth.
2. Are chronically plagued by inadequate laboratory and instructional equipment.
3. Are forced to accommodate large numbers of underprepared students.

These problems are of such magnitude that only the federal government, acting through the National Science Foundation in its role as the leader in science research and education, can affect the needed changes.

We call upon the National Science Board to recognize (a) the indispensable contribution that contemporary two-year colleges already make to undergraduate science and engineering education, and (b) their potential for greatly increasing that contribution provided they receive the guidance and support of the federal government at a level consistent with their current and potential role in educating America's next generation of scientists.



Community, technical, and junior colleges continue to provide the majority of American college students with their first experience in higher education. Two-year colleges enroll the largest share of undergraduates compared with private and public four-year colleges.



NORTHERN VIRGINIA COMMUNITY COLLEGE – ALEXANDRIA CAMPUS / PICKEREL

Community colleges are the first and best opportunity in postsecondary education for many students.

Faculty Growth and Development

We recommend that the National Science Foundation increase its level of activity in providing faculty development opportunities to college science teachers at minimum personal expense. Specifically, the NSF should

- support an expansion of the existing Institute for Chemical Education (ICE) that will enable ICE to provide in-service development for two-year college chemistry teachers;
- re-establish faculty development opportunities for college science teachers such as the College Science Improvement Program (COSIP), Chautauqua courses, and other programs for growth and renewal that are scheduled during times when faculty can participate; and
- establish programs to provide additional in-service education, via modern instructional delivery methods, to two-year college chemistry teachers who are unable to attend conferences and workshops.

Laboratory and Instructional Equipment

We recommend that the National Science Foundation increase its level of activity in supporting the acquisition of modern instrumentation in the two-year colleges. Specifically, the NSF should

- modify the Undergraduate Research Participation Program to encourage research by students (directed by two-year college faculty) in the two-year colleges;
- modify the College Science Instrumentation Program so that two-year colleges become eligible for funds;
- provide support for a number of regionally located and well-equipped, model science laboratories in two-year colleges;
- make umbrella grants to professional associations (or state two-year college agencies) which would then make smaller disbursements to individual colleges submitting proposals for the purchase of instruments costing under $3,000; and
- establish a program to support cooperative instrument repair services that could be used by a number of institutions in a geographic area.

Curriculum Improvement

We recommend that the National Science Foundation continue its support of exisiting programs in the new instructional technologies, such as Project Seraphim, and expand these efforts to specifically include material for use in two-year colleges. The Foundation should also establish new programs to take full advantage of modern electro-optical technologies, such as compact disks, teleconferencing, and videodisks, that would enable two-year colleges to bring enhanced learning opportunities to their students.

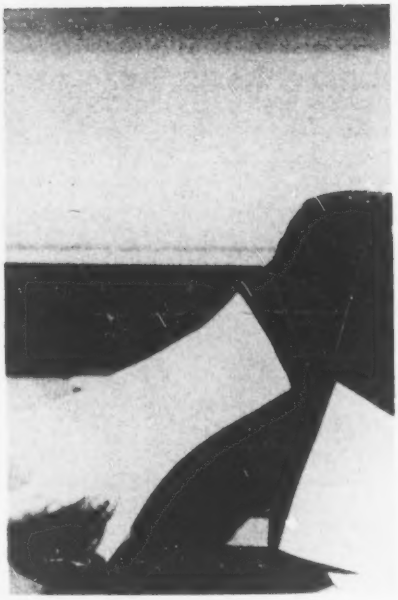
To the American Chemical Society Committee on Education

The Society Committee on Education (SOCED) is the ACS committee charged with establishing and monitoring the education policy of the Society. Because of its prominence in this area, the recommendations directed to SOCED are listed here, separate from those recommendations directed to other ACS governing bodies.

The Society Committee on Education has been an ardent supporter of programs for two-year college chemistry teachers for some time. This support became much more visible in 1984, when the Committee was instrumental in establishing the Two-Year Colleges Program within the ACS Education Division. The Two-Year Colleges Program publishes the *2YC Distillate*, a newsletter for two-year college chemistry teachers; collaborates in the preparation of guidelines for academic chemistry and chemical technology programs; and serves as a central mechanism for implementing the two-year college activities of the parent Society, its Division of Chemical Education, and other agencies operating in this area.

The 1984 report of the ACS Task Force for the Study of Chemistry Education in the United States, "Tomorrow," recommended that the Society take a more active role in two-year college chemistry education. In response to this, the Society Committee on Education established a Task Force on ACS Involvement in the Two-Year Colleges and devoted the 1985 Invitational Education Conference to the topic of issues in two-year college chemistry.

During the conference, it became apparent that the American Chemical Society is far and away the nationwide leader in two-year college science education. No other professional disciplinary organizations have the mechanisms in place to serve as the focal point for improvements in the science programs of two-year colleges. Because of this position, it is incumbent upon the Society, acting through its Committee on Education, to make every possible effort to implement the following recommendations.



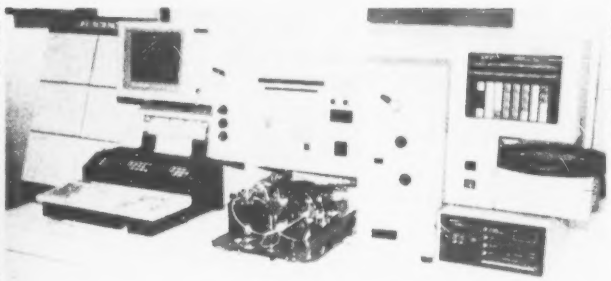
Guidelines for Chemistry Education in the Two-Year Colleges

We recommend that the Society Committee on Education direct its Task Force on ACS Involvement in the Two-Year Colleges to include in its guidelines for chemistry education in the two-year colleges

- an emphasis on the need for a full complement of developmental courses, including an assessment and advising system, designed to prepare students for college-level chemistry courses;
- a strong recommendation urging colleges to adhere to stated prerequisites for enrollment in a course;
- a strong recommendation that colleges provide chemistry courses for groups of students with specific needs, such as individuals majoring in allied health, occupational or engineering technology, general education, or science and engineering;
- a series of chemistry curriculum monographs, developed in cooperation with other professional societies, to guide the teaching of chemistry courses for students not majoring in science or engineering;
- an emphasis on the need for colleges to offer all courses for science and engineering students at least once each academic year;
- a strong recommendation that colleges be flexible in terms of both time and curriculum in the scheduling of chemical technology courses so that these courses meet the needs of all students, whether they are enrolled full-time, part-time, or for continuing education;

NORTHERN VIRGINIA COMMUNITY COLLEGE—ALEXANDRIA CAMPUS, J. PICKERELL

Two-year college chemistry teachers average 18 to 20 contact hours each week. Professional development for these dedicated individuals must be accompanied by financial support for travel and coverage of classes.



C&EN PHOTO, R. DAGANI

The purchase and maintenance of modern laboratory equipment is presently impossible for many two-year colleges.

. . . the American Chemical Society is far and away the nationwide leader in two-year college science education.

• an emphasis on the need for chemical technology programs to have an advisory group made up of college faculty, high school faculty, and local industrial representatives;

• a recommendation that colleges follow the progress of their former chemical technology and transfer students as a significant aspect of their self-evaluation program;

• a strong recommendation that college administrators adopt and maintain comprehensive programs for faculty growth and renewal;

• a plan that encourages the involvement of both administrators and chemistry faculty in budgetary decisions affecting the chemistry programs and acknowledges their respective responsibilities associated with governance and formal authority; and

• a clear statement to assist the college community in establishing appropriate teaching loads and in allocating the support services necessary for quality chemistry instruction.

Once completed, we recommend that these guidelines be sent to the appropriate regional accrediting agencies for reference in their accrediting activities.

Consultation and Outreach

We recommend that the Society Committee on Education encourage the College Chemistry Consultants Service to expand its activities in the two-year college area so that it becomes a mechanism for implementing the above guidelines in the nation's two-year colleges. This can be accomplished by the Service

• including more persons experienced in two-year college chemistry education in its list of consultants.

• establishing a mechanism for training the consultants in the use of the guidelines for chemistry education in the two-year colleges, and

• publicizing the availability of the consultants and guidelines, and encouraging colleges to use the Service during self-studies.

Public Understanding of Science

We recommend that the Society Committee on Education further its efforts in increasing the public's understanding of science by encouraging the staff Education Division to identify funding sources and submit proposals for projects to

• develop a set of curriculum materials for a course on "chemistry and society," similar to the existing **CHEMCOM** project but adapted to the college level; and

• prepare a series of 15 to 20 videotapes of well-known chemists and excellent teachers presenting lectures on topics at the science/society interface.

MONTGOMERY COLLEGE - TAKOMA PARK CAMPUS (MD) ACS PHOTO: J. BRADFORD

Two-year college partnerships with elementary and secondary schools can make a substantial improvement in science education.

Multidisciplinary Conferences

We recommend that the Society Committee on Education convene a multidisciplinary conference to bring together representatives of the professional scientific societies of biology, chemistry, engineering, geology, mathematics, and physics. The goals of this conference should be to

- address the issues of poor preparation and placement of science students;
- prepare a program, to be presented at the meetings of the American Association of Community and Junior Colleges, that raises common concerns in the areas of faculty needs and educational priorities to college administrators;
- develop a position paper that encourages college curriculum committees to include a course on science/society issues in the requirements for graduation;
- prepare materials to inform faculty members about the limitations placed on administrators by local fiscal and policy constraints;
- prepare materials to inform the public and public officials about the importance of supporting science education in the schools; and
- prepare recommendations to federal agencies similar to those in this publication that are addressed to the National Science Board.

Comprehensive Survey of Two-Year Colleges

We recommend that the Society Committee on Education collaborate with the American Association of Community and Junior Colleges on a comprehensive survey of the nation's two-year colleges. This survey should collect data on

- assessment and placement testing programs in chemistry;
- developmental and remedial chemistry courses;
- service courses for allied health, engineering technology, and other occupational majors;
- courses for chemistry and other science and engineering majors;
- courses for nonscience and nonengineering majors;
- courses and programs for chemical technology;
- course enrollments and attrition rates;
- high school backgrounds of students;
- articulation agreements between two- and four-year colleges;
- programs to follow the progress of both chemical technology and transfer program graduates;
- the current state of, and need for, laboratory and instructional equipment; and
- especially effective learning aids and teaching techniques for presenting chemistry to nonscience and specific occupational majors.

The results of this survey should be widely and appropriately distributed.

Instrumentation and Professional Development

We recommend that the Society Committee on Education, within the scope of its mission and influence, assist the efforts of the National Science Foundation in addressing two of the most pressing problems in two-year college science education. Specifically, the Committee should

- work through appropriate agencies to urge instrument manufacturers to make every effort to reduce the cost of instrument repair, perhaps through tax deductions for contributions to academic institutions;
- encourage the staff Education Division to identify sources of equipment donations and cooperative instrument repair services, and to publish this information; and
- encourage the staff Education Division to expand its efforts in identifying professional development opportunities for two-year college chemistry faculty, and to continue to disseminate this information.

To the Governing Bodies of the American Chemical Society

One of the great strengths of the ACS is the tremendous diversity of its members. Their widely varying interests and areas of expertise enable the Society to attack problems on many different fronts. We believe that the Society's committees and divisions, even those with missions other than directly improving education, have much to contribute to the solution of the problems facing two-year college chemistry programs.

We recommend that the information collected by the **Committee on Chemical Safety** for the handling and disposal of hazardous materials be widely distributed among two-year college faculty members.

We recommend that the **Committee on Grants and Awards** establish an industrially sponsored award for excellence in teaching and for contributions to chemistry education at the two-year college level.

We recommend that the **Committee on Professional Training** include in its guidelines publications a specific discussion of the importance of regular interaction among the faculties of two- and four-year colleges serving the same area. We also recommend that CPT work with the Society Committee on Education to collect data on the successes and problems experienced by two-year college students who transfer to four-year schools.

. . . the Society's committees and divisions, even those with missions other than directly improving education, have much to contribute . . .

We recommend that the **Committee on Technician Activities** conduct studies, on a regular basis, to determine the desirable characteristics of chemical technology programs and the relationships these programs should have with other academic areas and with the chemical industry. An additional goal of these studies should be to determine the manpower needs of the chemical industry for chemical technicians.

We recommend that the **Division of Analytical Chemistry** develop and distribute a registry of individuals, knowledgeable about specific instruments, who can provide information to colleges on the purchase, maintenance, and repair of instruments.

C&EN PHOTO: W. WORTHY

Industrially sponsored awards have been very successful in recognizing and publicizing excellence in teaching at the high school level.

We recommend that the **Division of Chemical Education**, in conjunction with its **Committee on Chemistry in the Two-Year Colleges**, stage professional development activities during ACS national and regional meetings that are especially attractive to two-year college chemistry teachers. One component of these activities should be workshops that bring together representatives from the colleges' research offices, foundation offices, public communication offices, administrations, and chemistry faculties to share information about locating funds for chemistry departments.

We recommend that the members of the **ACS Local Sections** make every effort to bring two-year college chemistry faculty members into the mainstream of ACS activities. We also recommend that local section members work with the two-year colleges to establish advisory committees for academic chemical technology programs, and to establish mechanisms for continuing industrial education, job exchanges between industry and academe, cooperative education, and public understanding of chemistry projects.

K. WALTON

To the Colleges

Addressing the problems facing two-year college chemistry education may, to a large extent, require the intervention of organizations whose missions are national in scope. This is not to say, however, that there is not much to be done at the state and local levels. It is the responsibility of the individual colleges and their governing bodies to initiate and sustain activities that improve science education in the United States.

College Faculty

We recommend that chemistry teachers in two-year colleges establish advisory groups to bring together faculty members, industrial representatives, and administrators for the purpose of sharing needs and expectations. Faculties should work with ACS local sections to identify the industrial representatives for these advisory groups.

We recommend that chemistry teachers in two-year colleges establish ongoing programs with four-year college chemistry faculty to help minimize articulation problems for transfering students.

We recommend that chemistry teachers in two-year colleges participate regularly in continuing education to maintain and enhance their skills and knowledge.

We recommend that qualified chemistry faculty actively participate in developing and delivering continuing education programs for local industry.

Top right: With proper stimulation, inquisitive young minds will see chemistry as a positive aspect of education. Two-year colleges can help precollege teachers in this effort.

Participating in continuing education is a necessity, not a luxury.

C&EN PHOTO, W. WORTHY

College Administrators

We recommend that two-year college administrators and collective bargaining units encourage and support (both with funds and with the coverage of classes) the participation of faculty members in conferences, meetings, and other professional activities.

We recommend that two-year college administrators encourage their chemistry faculties to participate in regularly scheduled self-studies, perhaps with the help of the College Chemistry Consultants Service, especially in anticipation of reviews by external accrediting agencies.

College Governing Boards

We recommend that state boards of higher education establish criteria for implementing firm articulation agreements that will ensure that four-year colleges award appropriate credit for equivalent courses taken in a two-year college.

We recommend that state boards of education sufficiently fund two-year college chemistry programs so that they are able to satisfactorily prepare students for transfer to senior institutions or for immediate employment in occupations that require chemical training.

We recommend that state boards of education and teacher certifying agencies recognize the potentially valuable role of the two-year colleges in the retraining of kindergarten-through-twelfth-grade teachers; and that they establish programs that would enable the two-year colleges to contribute to the improvement of precollege education. These programs should provide funds for workshops, seminars, and short courses to be held at two-year colleges. The K-12 teachers should receive continuing education credit for completing this work. This credit should also be adequately recognized in salary and tenure decisions.

It is the responsibility of the individual colleges and their governing bodies to initiate and sustain activities that improve science education in the United States . . .

To Other Professional Organizations

Professional associations, academe, and industry can work together to increase the public's understanding of chemistry and all science.

Overcoming academe's natural resistance to change will require a leverage that can come only from a united effort . . .

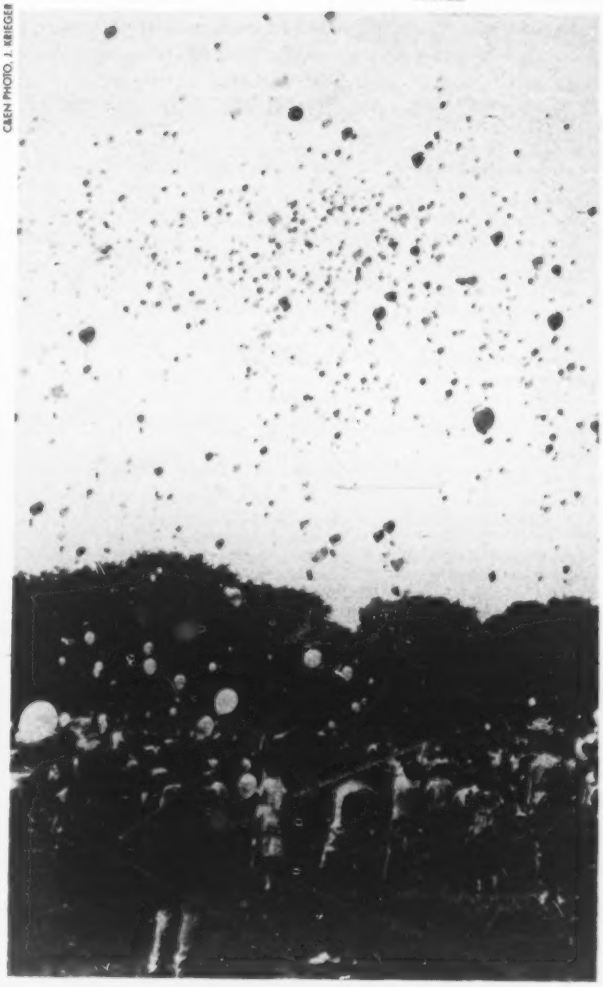
The interdisciplinary nature of modern science education necessitates the cooperation of the scientific societies to accomplish genuine and lasting improvements in the preparation of the next generation of scientists and engineers. Furthermore, overcoming academe's natural resistance to change will require a leverage that can come only from a united effort of the scientific disciplines and accrediting organizations.

We recommend that disciplinary organizations such as the **American Association of Physics Teachers**, the **National Association of Biology Teachers**, the **National Association of Geology Teachers**, and the **American Institute of Chemical Engineers** convene critical issues conferences and develop guidelines and consultation programs similar to those being conducted by the Task Force on ACS Involvement in the Two-Year Colleges.

We recommend that the **Triangle Coalition** establish a two-year college program within its existing structure.

We recommend that the **Commission on Postsecondary Accreditation**, the **American Association of Community and Junior Colleges**, and the **American Chemical Society** cooperate in the formation of a task force to study ways in which the regional accrediting associations and the scientific disciplinary organizations can work together to improve the quality of two-year college science education through the regional accrediting process. This task force should investigate such techniques as increasing the use of science faculty and science divisional administrators on accrediting teams, encouraging self-studies of science programs as a part of an overall self-study, and using the discipline-oriented guidelines to assist in both the self-study and accrediting processes.

C&EN PHOTO, J. KRIEGER



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Corning Glass Works (NY)

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*Task Force on ACS Involvement in the Two-Year Colleges
†Report Editors

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2YC3 newsletter

An Activity of
THE COMMITTEE ON CHEMISTRY IN THE TWO-YEAR COLLEGES
DIVISION OF CHEMICAL EDUCATION
AMERICAN CHEMICAL SOCIETY

TWO-YEAR COLLEGE CHEMISTRY CONFERENCE

1989 EXECUTIVE COMMITEE

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Past Chairs	Edith Bartley Onofrio Gaglione Jay Bardole Tamar Susskind Katherine Weissman

TABLE OF CONTENTS Vol. 89-II

Conference Calendar ..... p. 1-2
Thoughts From the Chair ..... p. 3-4
Survey ..... p. 5
News Items ..... p. 6-8
106th 2YC3 - Preliminary Program ..... p. 9-10
105th 2YC3 - Program ..... p. 11-12
105th 2YC3 - Accomodations/Map ..... p. 13-14
105th 2YC3 - Pre-registration Form ..... p. 15

Meeting Programs in this issue

105th CONFERENCE

May 19-20	Cerritos Community College 11110 E. Alondra Blvd. Norwalk, CA 90650-9973 (213) 860-2451
Program Theme	Chemical Education: How Effective Is It?
Program Chair	Christine Romer Cerritos Community College 11110 E. E Alondra Blvd. Norwalk, CA 90650-9973
Local Arrangements Chair	James R. Peter, same campus
Local Industrial Sponsors Chair	Mervat Zewail, same campus

106th CONFERENCE - Preliminary Program

Oct. 6-7, 1989	Jefferson Community College, P.O. Box 1036 Louisville, KY 40202 Chem. Off.(502) 584-0181 Ext. 204
Program Theme	Mixing It Up For The 90's 1st Focus: Integrated/Interdisciplinary Approaches to Chemistry 2nd Focus: Development & Retention of Science (Chem.) Students 3rd Focus: New Laboratory Techniques & Concerns
Program Chair	Nik Kakolesha, Elizabethtown C. C., Elizabethtown, KY 42701, (502) 769-2371
Local Arrangements Chair	Patricia McCoy Brown, Jefferson Community College P.O. Box 1036, Louisville, KY 40202 (502) 584-0181, Ext. 277 or 204
Local Industrial Sponsors Chair	William (Bill) Baker, General Electric, Louisville, KY 40202 (502) 361-3300

FUTURE CONFERENCES

Future Meeting 1989 Calendar Year

107th CONFERENCE
(Southern Region)

Nov. 17-18, 1989

Mississippi Gulf Coast Community College, Jefferson Davis Campus, Switzer Road, Gulfport, MS 39507 (601) 896-3355

Program Theme: Polymer Chemistry: Academics, Industry, and Research
Program Chair: James M. Knight, Miss. Gulf Coast Comm. Coll., Jefferson Davis Campus Office: (601) 896-3355 Ext. 144, Home: (601) 875-5884
Local Arrangements Chair: Ed Decker, Miss. Gulf Coast Comm. Coll. Office (601) 896-3355 Home: (601) 896-8377
Local Industrial Sponsors Chair: Janie Languirand, Miss. Gulf Coast Comm. Coll. (601) 896-3355
Comments: Excellent location near beach, motels, restraurants, special rates. Near Gulfport-Biloxi airport; limosine service possible to New Orleans Airport.

Future Meetings 1990 Calendar Year

108th CONFERENCE
(Eastern Region)
Preceding the ACS National Meeting, Boston
April 22-27, 1990

April 20-21, 1990
Roxbury Community College, 1234 Columbus Ave, Roxbury Crossing, MA 02120-3400

Program Theme: TBA
Program Chair: Dorothy (Dotty) Stumpf, Middlesex Comm. Coll., Springs Rd., Bedford, MA 01730 (617) 275-8910 Ext 287
Local Arrangements Chair: Dorothy Higgins, Roxbury Community College, 1234 Columbus Ave., Roxbury Crossing, MA 02120-3400 (617) 541-5317
Local Industrial Sponsors Chair: Muriel Kanter, 130 Rosseter Street, Dorchester, MA 02121, (617) 282-7139

109th CONFERENCE
(Western Region)

June 15-16, 1990

Capillano College, 2055 Purcell Way North Vancouver, BC V7T 3H5 (604) 986-1911

Program Theme: Chemistry on the Pacific Rim
Co-Program Chairs: William Wasserman, Seattle Central Community College Seattle, WA 98122 (206) 587-4083
Alan Davis, Fraser Valley College Abbotsford, BC
Local Arrangements Chair: Penny LeCouteur, Capillano College, North Vancouver
Local Industrial Sponsors Chair: TBA

110th CONFERENCE
In conjuction with the 11th Biennial Conference on Chemical Education

Aug. 6-10, 1990

Georgia Institute of Technology, Atlanta, GA
2YC$_3$ Program Chair: Leo Kling III Faulkner State Junior College Bay Minette, AL 36507 (205) 937-9581
2YC$_3$ Booth Chair/Committee: T.B.A.

111th CONFERENCE
(Midwestern Region)

Oct. 5-6, 1990

Elgin Community College, 1700 W. Spartan Ave., Elgin, IL 60123

Contact Person: Dr. Lavoir Banks
Elgin Community College, 1700W. Spartan Ave, Elgin, IL 60123
(312) 697-1000, ext. 320

THOUGHTS FROM THE CHAIR

There are two topics that I'd like to discuss with you. Both are resources for further development of two-year college chemistry education. As I stated in the last Newsletter, one of my goals is to involve more people in our organization. I would also like to make you aware of some of the many resources available to you.

On the page 5 of this Newsletter you'll find another survey form. It is a result of one of my duties as $2YC_3$ Chairman. I serve as a member of the ACS Society Committee on Education's Task Force on Two-Year Colleges. Its four-part charge is listed at the top of the survey form. Other $2YC_3$ members currently serving on the Task Force are Jay Bardole, Harry Hajian, Bill Mooney, Uni Susskind, and Kathy Weissman.

Not long ago I participated for the first time in a two-day working session of the Task Force. I found a dedicated, hard-working group, extremely interested in two-year college chemistry education and the role our colleges can play in the country's educational process. Among their major accomplishments has been the production of the documents *Critical Issues in Two-Year College Chemistry: Report With Recommendations* and *Guidelines for Chemistry and Technology Programs in Two-Year Colleges*. Both of these documents have been useful in explaining the role and needs of two-year colleges to legislators and funding agencies. The Task Force and the ACS Office of College Chemistry will continue to seek a broad distribution of these documents. They are also developing supplementary materials and lists of model programs to be used in conjunction with the *Guidelines*.

The *Guidelines* can be extremely useful as you work to improve your own chemistry program. They can help you demonstrate the strength of what you've already accomplished, and they serve as a standard against which to base your requests for improvement. You might find them useful when discussing your chemistry program with your college administration as well as in explaining the two-year college mission to those outside your institution.

The Task Force also has been actively involved in the revitalization of the ACS College Chemistry Consultants Service (C_3S) as it applies to two-year colleges. There was a News Item about requesting specially funded consultants' visits in the last Newsletter. However, even without one of these specially funded visits, you may wish to consider using the the ACS College Chemistry Consultants Service. They can help you examine your overall chemistry program or focus on specific areas such as curriculum updating, new course development, safety procedures, grant procurement, and budgetary matters. Their assistance is available at reasonable cost through the ACS Office of College Chemistry.

The second topic I'd like to discuss is the growing awareness and interest at the local, state, and national levels that two-year colleges fulfill a vital mission in the science education "pipeline". The term "pipeline" refers to the preparation of students for the scientific and technological work force. A feature of this pipeline that is generating much discussion is that the number of students who express an interest in careers in science and mathematics decreases dramatically (40%) between the end of the senior year in high school and the end of the freshman year in college. As the number of traditional college age students is also declining, there is great interest in getting more non-traditional students, particularly minorities and women into the pipeline.

This is one place where community colleges can make a significant impact in education. Two-year colleges presently enroll 41% of all undergraduate credit students, 55% of all first-time college freshman, and more than 50% of all minority students.[1] Approximately 80% of minorities in higher education enter through a two year college.[2] In addition to

this, we educate a high proportion of women of non-traditional college age who are returning to school. I believe that community colleges are in a wonderful position to show that, with our emphasis on science education, not only can we increase the number of women and minorities going through the pipeline, but also provide a point of re-entry to those students who had left earlier.

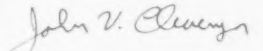
Our role in this pipeline is indeed critical and is being recognized as such by Congress and such federal funding agencies as the National Science Foundation. Of particular significance to us is the fact that last year (FY 88) NSF opened its Instrumentation and Laboratory Improvement program to two-year colleges. In our first year, we did extremely well in the program. Out of a total of $11 million in awards, $1.2 million were awarded to two-year colleges. A complete list of award announcements can be obtained from NSF at the address below.[3]

However, with this privilege goes a serious responsibility. We are now expected to compete on an equal footing with four-year college and university chemists, many of whom have much more experience in grant-writing than the typical two-year college instructor. We have an obligation to work hard to improve our grant-writing skills, and to produce even better proposals in the future.

To help you with the process, I've made a special request to each of the program chairs of the 1989 Conferences to add time for a special section on writing grants, particularly for the ILI program. Presenters will be two-year college chemistry instructors who have served as panelists for this program. They can't develop a project and write the proposal for you, but they can provide valuable information about how the process works and suggestions based on their participation in the review process. Although the program for the 104th $2YC_3$ at Irving, TX, published in the last Newsletter, was finished before I made this request, Weldon Burnham, Program Chair, graciously agreed to add the grant writing presentation after the last scheduled presentation on Saturday. If you're attending that conference, please plan to stay on just a little longer. If you can attend this session at one of the other meetings, please do.

I look forward to seeing you at one of our Conferences to learn and share ideas about this and many other topics. See you there!

John V. Clevenger

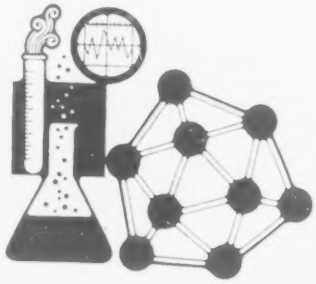


1989 Chairman COCTYC

1. *Critical Issues in Two-Year College Chemistry*

2. National Council of Educational Opportunity Associations

3. Instrumentation and Laboratory Improvement Program,
Office of Undergraduate Science,
Engineering, and Mathematics Education
1989 Chairman,COCTYC
Directorate for Science
& Engineering Education
Room 639
National Science Foundation
1800 G Street, NW
Washington, D.C. 20550
Telephone: (202) 357-7051



SURVEY

GUIDELINES SURVEY
PLEASE COPY AND DISTRIBUTE TO INDIVIDUAL FACULTY

Copies of the *Guidelines for Chemistry and Technology Programs in Two-Year Colleges* have been sent to all two-year colleges and several other target groups. These guidelines were developed by the ACS Society Committee on Education's Task Force on Two-Year Colleges established in 1983 with a four-part charge:

1. Revise the 1970 *Guidelines for Chemistry in the Two-Year College* to reflect the diversity of chemistry education responsibilities that have become the norm for individual two-year colleges in the past 15 years.
2. Develop an outreach and consultation program which would make the expertise of the Society staff membership more effectively available to two-year college administrators whose institutions are engaged in substantial efforts at improving the quality of their chemistry programs.
3. When the revised *Guidelines* have been published and the outreach and consultation program is functioning, the ACS should undertake to certify/approve Chemical Technology programs in two-year colleges at the request of such institutions.
4. When recommendations 1,2, and 3 have been implemented, the ACS should undertake to certify/approve college transfer programs in two-year colleges at the request of such institutions.

Charges 1,2, and 3 are completed or are well underway. There has been considerable discussion regarding whether charge 4 should be implemented. The Task-Force is very interested in the distribution and use of the *Guidelines* and anxious to know how the question of implementation is perceived by the people most concerned. Your reaction to these questions would be extremely useful.

Please respond to the following questions and return this survey to:

Jay Bardole, Division of Science & Math
Vincennes University,
Vincennes, IN 47591

Have you seen a copy of the *Guidelines*? ❑ Yes ❑ No
If your answer was no, and you would like a copy, please contact the Office of College Chemistry, American Chemical Society, 1155 16th St., N.W., Washington, D.C. 20036-4899 (202) 872-4587

Have the *Guidelines* been useful to you? ❑ Yes ❑ No Please explain

_____

_____

_____

Should the *Guidelines* be used to certify/approve college transfer programs in two-year colleges?
❑ Yes ❑ No Please explain

_____

_____

_____

_____

Call For Nominations for Chair-Elect 1991

The $2YC_3$ Policies and Procedures for the nominations of candidates for the office of Chair-Elect, require that a call for nominations be included in the second spring and the first fall newsletters each year. Nominations must be received by the Chair no later than noon Saturday of the first fall conference. That will be October 7, 1989. Nominations for Chair-Elect 1991 should be sent to:

John V. Clevenger,1989 Chair
Committe On Chemistry in the
Two-Year College
Truckee Meadows Community College
7000 Dandini Boulevard
Reno, NV 89512

To be eligible for the office of Chair-Elect, and individual must:
(a) be a two-year college chemistry teacher.
(b) have been a dues-paying member of $2YC_3$ for a minimum of three years prior to nomination.
(c) be a member of ACS and DivCHED.
(d) have demonstrated leadership and organizational ability by serving as Chair or Co-Chair for a conference and in one or more of the following capacities:
(1) Served three years on the Executive Committee.
(2) Served as Local Arrangements Chair for a conference.
(3) Chaired a sub-committee.
(4) Contributed within the past three years in two or more ways such as: acted as local industrial sponsor coordinator, chaired a conference section, presented a paper at a conference, moderated a panel at a conference, and so on.

It is highly desirable that the Chair-Elect's college be agreeable to helping with certain expenses such as printing, mailing, telephone, typing, and travel during the three year period of commitment.

Nominations for this office must include:
(a) pertinent personal data such as name, college, job title, address, etc.
(b) a statement of qualifications signed by the nominee.
(c) signed consent of the nominee.

Consider Helping A High School Teacher with a Science, Technology and Society Minigrant

A new program offering high school teachers up to $1,000 in materials development funds has just been announced by the ACS. The ACS-STS Minigrants will fund projects focusing on the relations among, science, technology, and society (STS) issues.

Teachers may use the grant funds either to produce their own, original lessons and resources that might be used over two to four days, or they may design a curriculum module using existing materials to comprise a four- to nine- week unit. Hands-on activities and an emphasis on problem solving, decision-making, and critical thinking skills are particularly encouraged.

The goals of the ACS-STS Minigrants are to help students understand science in its societal context, to assist teachers in developing and implementing innovative curriculum, and to form a cadre of experienced teachers and a selection of programs to serve as models for continued evolution of science programs.

The project director must be a high school teacher who is a member or national affiliate of the ACS. Other participants may include other teachers, college and university professors, or members of local industry. The application deadline for projects scheduled to begin in the fall of 1989 is March 31, 1989. For details and an application packet call or write: David Licata, Manager, Office of Precollege Science, American Chemical Society, 1155 16th St., NW, Washington, DC 20036 (202) 872-4590.

ACS Career Publications

The ACS Office of Career Publications offers a variety of booklets designed to help science students with choosing a career. Your college may want to take advantage of this service to build a library of career materials. A single copy of one or two booklets is free. Orders for multiple copies must be prepaid. For a free catalog of career and other educational materials, call or write: American Chemical Society, Education Division, 1155 Sixteenth Street, NW, Washington, DC 20036, (202) 872-4380.

Some of the publications available are:
Careers in Chemistry: Questions and Answers- Answers the questions asked most often by high school students about chemistry careers, what chemists do, and how to prepare for future studies.
A Career as a Chemical Technician - Describes the variety of tasks chemical technicians perform, necessary skills and preparation, salary range, employment outlook, and advancement potential.
Careers in Chemical Education - Three articles describing chemical education careers from secondary teacher through university professor.
Chemical Careers in the Life Sciences - Three articles describing chemical careers in clinical chemistry, biochemistry, and medicinal chemistry.
I Know You're a Chemist, But What Do You Do? - Twenty-six chemists with bachelors degrees were asked to describe their jobs and provide advice on what can be expected while job-hunting and after employment.
Current Year Salary Survey - A report on current salaries and trends for all areas of chemistry and chemistry-related fields.
Current Year Employment Outlook - A report on the current outlook for career opportunities in chemistry, analyzing potential demand, salaries, and career planning.

The History of Chemical Education in the United States: An Exhibit Commerating the 50th Anniversary of the ACS Student Affiliates Program

An exhibit tracing the history of chemical education in the United States has been developed to commemorate the 50th anniversary of the founding of the ACS Student Affiliates Program. Although its focus is on the student experience, the exhibit also chronicles the relationship between chemical education and the professions pursued by students of chemistry.

The exhibit shows that students have been studying chemistry in the United States for more than 300 years. By the early 1800's, every major college in the country included chemistry in its teaching. Yet the modern form of instruction in chemistry-lectures combined with laboratory experience - did not become widespread until after the Civil War. A century ago, prominent chemistry professor, Ira Remson, argued that a chemical education was valuable because the "absolute accuracy, absolute fidelity, and absolute honesty" of the scientific method force a student's mind into rigorous habits of thought.

If you would like more information on this exhibit or on the ACS Student Affiliates Program, please contact: American Chemical Society, Student Affiliates Program, 1155 16th St., N.W. Washington, DC 20036, (202) 872-4480.

Chemical Risk Communication Handbook Available

As the Community Right-To-Know-Law (Section 313 of SARA Title III) goes into effect, you may become a local resource for the public seeking information about the risks from chemical releases. This law requires facilities to report to EPA and to state and local governments the amounts of more than 300 chemicals that are routinely released into the environment. The American Chemical Society has published a handbook that discusses risk assessment concepts and risk communication techniques- *Chemical Risk Communication—Preparing for Community Interest in Chemical Release Data.* The handbook is aimed at the persons who bear the public communication obligations, but may be useful to anyone involved in explaining environmental pollution exposures, and risks. It was written as a guide to encourage citizen discussions that are productive and constructive. For a free copy of the handbook, send a self-addressed mailing label to Ms. Tanja Lewis, ACS, Department of Government Relations and Science Policy, 1155 16th Street, NW, Washington, DC 20036

Summer Educational Experience for the Disadvantage

Project SEED started its twenty-first year this month with a mailing to all two-year college chemistry department chairs. This program is an innovative career development activity administered by ACS for economically disadvantaged high school students. SEED students spend ten weeks during the summer doing research in a laboratory under the supervision of a faculty member. Students can earn a small stipend, receive career and college counselling, and participate meaningfully in research. The personal relationship between the student and faculty is a key factor in helping the student raise his/her goals and expectations. The faculty also benefit by gaining experience working with these young men and women from cultural backgrounds that are greatly different from the average college student. If you are interested in hosting a SEED student for the summer call or write: American Chemical Society, Education Division/Project SEED, 1155 16th St., NW, Washington, DC 20036 (202)872-4380. Applications for participation this year are due March 3.

New "Safety Tips" Feature in *Journal of Chemical Education*

Do you have any safety tips, hints, or practices that work particularly well? Or perhaps you have some thoughts on safety you would like to share with your fellow science teachers. Why not write an article for "Safety Tips," the *Journal of Chemical Education* feature devoted to safety practices for the secondary and two-year college levels? Articles on all aspects of safety from devising new and safer experiments to specific "tricks of the trade," will be considered. Send completed manuscripts or write for manuscript guidelines to:

Dr. Clair G. Wood, Editor
Safety Tips
E.M.V.T.I.
354 Hogan Road
Bangor, ME 04401

106th CONFERENCE
Jefferson Community College
P.O. Box 1036
Louisville, KY 40202

October 6-7, 1989

Preliminary Program

Program Theme: Mixing It Up For the 90's
1° Focus: Integrated/Interdisciplinary Approaches to Chemistry
2° Focus: Development & Retention of Science (Chem) Students
3° Focus: New Laboratory Techniques & Concerns

Program Chair: Nik Kakolesha
Elizabethtown C.C., Elizabethtown, KY 42701
(502) 769-2371

Local Arrangements Chair: Patricia McCoy Brown
Jefferson Community College
P.O. box 10326, Louisville, KY 40202
(502) 584-0181, est. 277 or 204

Local Industrial Sponsors Coordinator: William (Bill) Baker, General Electric, Louisville, KY 40204
(502) 361-3300

Speakers and Topics Include:

Janet Schweitzer & Vera Quinn, Jefferson Community College, "Interdisciplinary Approaches to Teaching Science."

Jay Bardole, Vincennes University and member of the Task Force on Two-Year Colleges, "What Has The Task Force Done For You?"

Terri Nally, Office of College Chemistry, American Chemical Society, "Two-Year Collegs, ACS, and Capitol Hill,"

"Writing Grants for Instrumentaton and Laboratory Improvement" presented by former review panelists.

Microscale Laboratory Workshop

If you're interested in presenting a paper relating to the themes of this conference, please contact the program chair, Nik Kakolesha, with a title and brief description of your paper.

WE NEED 50 PEOPLE!

Please turn the page

CONFERENCE RECREATION

2YC$_3$ On The River!

We're planning a river boat cruise on the Bonnie Belle, but we need to know if you're interested. On Friday evening, October 6, there would be 3 hours of good food, music, and entertainment on the beautiful Ohio river and **no after-dinner speaker**. We need to know how many of you are interested by June 1. If you're interested, we need you to send money to reserve your space by August 1. The cost is $ 26.95, gratuity and taxes included. **We need 50 people by August 1.**

If you would like more information about the conference, the Louisville area, or the Bonnie Belle cruise, please fill out the form below and mail it to:

Patricia McCoy Brown, Jefferson Community College,
P.O. Box 1036, Louisville, KY 40202

Name _____

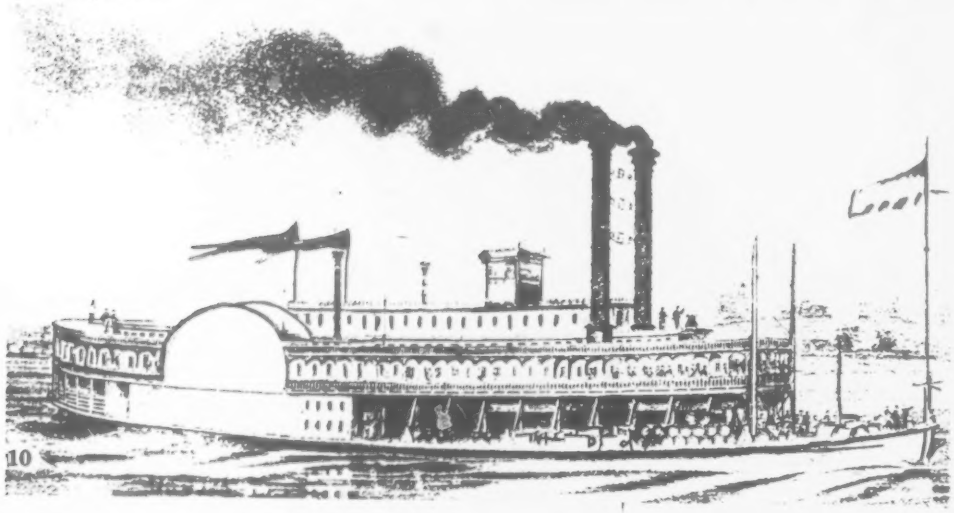
College _____

City _____ State _____ Zip _____

❑ Please send more information about the conference and the area

❑ Yes, I'm interested in the Bonnie Belle riverboat cruise and plan to come to the conference (we need this count by June 1)

❑ Yes, I'm coming to the conference and want to reserve a spot on the Bonnie Belle. Enclosed is a check for $26.95 payable to 2YC$_3$. **We need 50 people by August 1.**



105th TWO-YEAR COLLEGE CHEMISTRY CONFERENCE
Cerritos Community College
11110 East Alondra Boulevard
Norwalk, California 90650

Friday, May 19 and Saturday, May 20, 1989

Program Theme: Chemical Education: How Effective Is It?

For additional information about the program or arrangements, please contact:
Program Chair: Christine Romer, Cerritos Community College, (213) 860-2451, ext. 305 or 340

Local Arrangements: James Peter, Cerritos Community College, (213) 860-2451, ext. 354 or 340

Local Industrial Sponsors Coordinator: Mervat Zewail, Cerritos Community College, (213) 860-2451, ext. 396 or 340

Friday, May 19, 1989

9:00-3:00 Registration, exhibits, coffee—Natural Science Rooms 5 & 6

9:30-10:45 Committee on Chemistry in the Two Year Colleges, John Clevenger, COCTYC Chair, presiding. Physical Science Room 8. This meeting is open to all interested persons.

10:50-11:20 Opening Ceremonies, Lecture Hall Room 4.

11:20-noon Professor Amy Lee, Norris Cancer Research Institute, University of Southern California School of Medicine, Los Angeles, CA
"Application of Recombinant DNA"
Presiding: Douglas Bond, Riverside City College, Riverside, CA

Noon-1:30 Buffet Lunch, Student Center

1:30-2:10 Professor Herbert Thier, University of California, Berkeley, CA
"Chemical Education for Public Understanding Program"
Presiding: Ruth Sherman, Los Angles City College, Los Angeles CA

2:15-2:55 Professor Arlene Russell, University of California, Los Angles, CA
"Chemical Education for Public Understanding Program"
Presiding: Robert Hubbs, DeAnza College, Cupertino, CA

3:10-3:55 Professor Maria Linder, California State University, Fullerton, CA
"Nutrition and Chronic Diseases."
Presiding: Joe Brundage, Cuesta College, San Luis Obispo, CA

CONFERENCES

4:00-4:40	Professor Carcy Chan, East Los Angles College, Monterey Park, CA *"One Third of a Nation, Our Challenge in the 1990s."* Presiding: Elizabeth Armstrong, Skyline College, San Bruno CA
5:00-6:00	Break
6:00-6:30	No host Social Hour, Gateway Plaza Holiday Inn
6:30-9:00	Banquet and Keynote Address—Gateway Plaza Inn, La Mirada, CA Professor Paul Saltman, University of California, San Diego, La Jolla, CA *"Science and Human Values...One Culture."*

Saturday, May 20, 1989

8:30-noon	Registration, coffee, exhibits—Natural Science Rooms 5 & 6 Meetings: Lecture Hall Room 4
9:00-9:40	Professor Lucy Pryde, Southwestern College, Chula Vista, CA *"Chemistry in the Community (ChemCom): How it Will Change Your Teaching."* Presiding: Judy Okamura, San Bernardino Valley Coll., San Bernandino, CA
9:45-10:25	Mr. Roland Ganges, Thomas Jefferson High School, Los Angeles, CA *"Chemistry: An Interdisciplinary Approach"* Presiding: Gilbert Albelo, Mt. Hood Community College, Gresham OR
10:25-10:235	BREAK
10:35-11:15	Professor Majorie Gardner, University of Berkeley, CA *"Internationalizing Chemical Education"* Presiding: Arthur Hubscher, Ricks College, Rexburg, ID
11:20-noon	Ms. Connie Boardman, Warren High School, Downey, California *"Chemistry and Physical Science Demonstrations."* Presiding: Susan Arena, Mt. San Antonio College, Walnut CA
Noon-1:30	Buffet Lunch, Student Center
1:30-2:10	Professor Karen Timberlake, Los Angeles Valley College, Van Nuys, CA *"Using Writing to Learn Chemistry."* Presiding: Charles Cowell, Rancho Santiago College, Santa Ana, CA
2:15-2:55	Professor Danette Dobyns, CA State Univ., Dominguez Hills, Carson, CA *"Chemistry for Citizens."* Presiding: Newton Werner, Cerritos Community College, Norwalk CA
2:55-3:10	BREAK
3:10-4:00	Ms. Jody Chase, Truckee Meadows Community College, Reno, NV *"Writing Grant Proposals for Laboratory Improvement—Where Do I Start?"* Presiding: John Clevenger, Truckee Meadows Community College, Reno, NV

20-696 - 89 - 7

HOTEL & TRANSPORTATION

It is **strongly recommended** that you stay at the **Gateway Plaza Holiday Inn** which will be the site of the Friday Evening Banquet. A block of rooms have been reserved for Thursday and/or Friday nights at a special rate for the meeting. Please make your reservations directly with the hotel. In order to qualify for the special rate you must mention Cerritos College/2YC$_3$. The cutofff date for reservations is May 5, 1989. Any request received after this date will be accepted on a space available basis. The hotel will honor the special rate three days prior and three days after the meeting in case you want to spend additional time in Southern California.

RECOMMENDED HOTEL

Gateway Plaza Holiday Inn
14299 Firestone Blvd.
La Mirada, CA 90638
(714) 739-8500
(213) 721-8500
1-4 Person(s) $55 + tax

Ramada Inn
12500 Firestone Blvd.
Norwalk, CA 90650
(213) 868-0401
(800) 367-8513
1 Person $62 + tax
2 Persons $71 + tax

Travel Lodge/Artesia
11854 Artesia Blvd.
Artesia, CA 90701
(213) 402-0070
(800) 255-3050
1 Person $39 + tax
2 Persons $44 + tax

Best Western Norwalk Inn
10902 Firestone Blvd.
Norwalk, CA 90650
(213) 929-8831
(800) 528-1234
1 Person $50.88 inc. tax
2 Persons $55.12 inc. tax

Best Western Pioneer Inn
16905 S. Pioneer Blvd.
Artesia, CA 90701
(213) 402-2202
(800) 528-1234
1 Person $50 + tax
2 Persons $55 + tax

Transportation

A. Shuttle Service

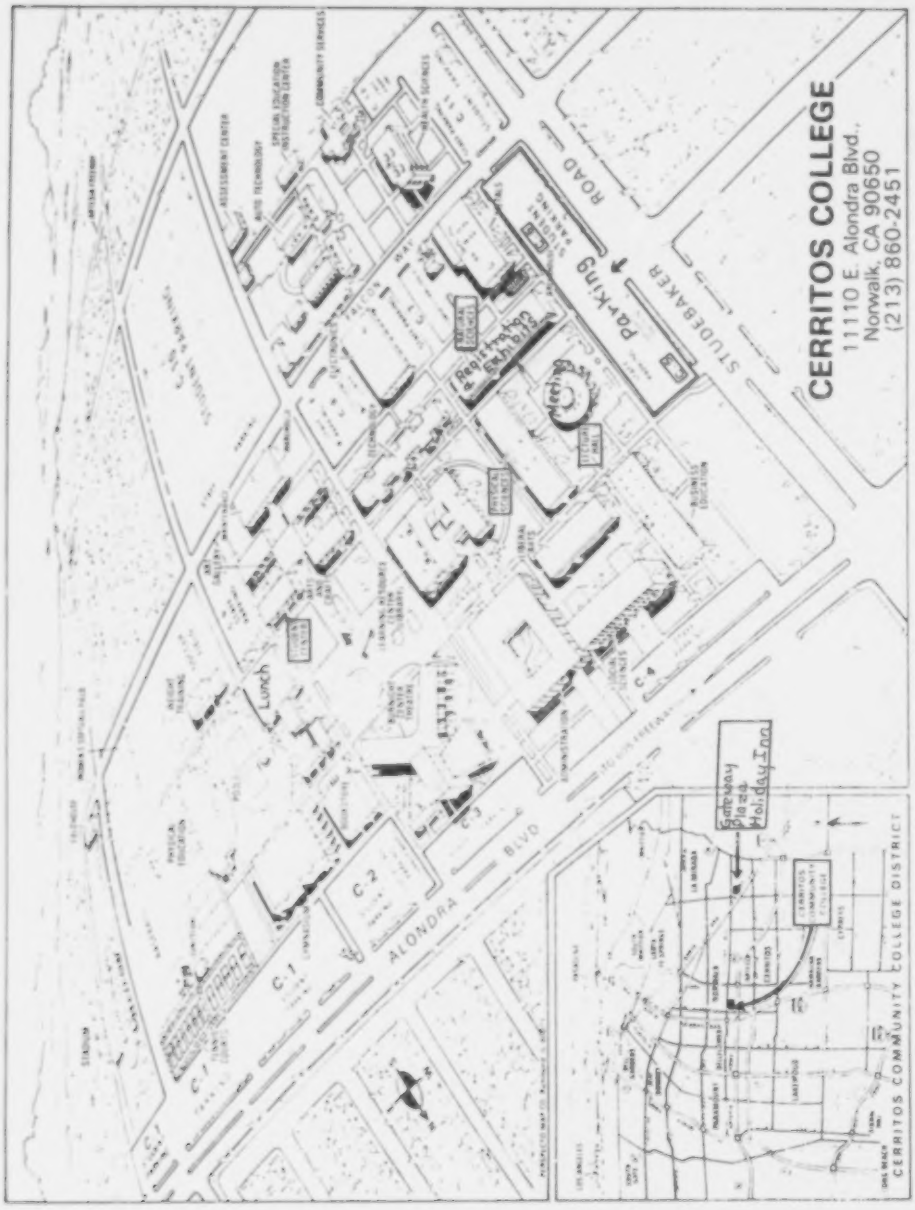
Please make your own reservations. Transportation between **Gateway Plaza Holiday Inn** and the **Long Beach Airport** is provided free by the hotel by reservation. Service from the Los Angeles Airport (LAX) to the Gateway Plaza Holiday Inn is provided by Super Shuttle (213) 338-1111 or (714) 973-1100 or (800) 334-8088. The cost is $16 per person. Advance tickets can be purchased at the hotel for $14.

Round trip transportation between the **Gateway Plaza Holiday Inn** and **Cerritos College** will be by college vans on Friday and Saturday. Look for the vans near the hotel lobby about one half hour before registration time in the mornings. If you stay at one of the other listed motels and you inform us of your location, we will attempt to provide van transportation. If you have trouble with transportation (especially late arrivals), notify the college at 860-2451, ext. 340.

B. Automobile Arrival

See accompanying map. Get off the 605 Freeway at Alondra Blvd. Proceed east to Studebaker Road (approx 2 blocks). Turn right on Studebaker and proceed about 1/2 block to the entrance to the parking lots where you will make a left turn. Park in lots C-5 or C-6. Arrangements have been make with the Campus Police to not require parking permits in these two lots on Friday and Saturday.

MAP


CERRITOS COLLEGE
11110 E. Alondra Blvd.
Norwalk, CA 90650
(213) 860-2451
STUDEBAKER ROAD
Parking
ALONDRA BLVD
Lunch
Registration Exhibits
Gateway Plaza Holiday Inn
CERRITOS COMMUNITY COLLEGE DISTRICT

REGISTRATION FORM

Name _____

Institution _____

Institution Address _____

City _____ State _____ Zip _____

1989 Membership ❑ $2YC_3$ ❑ ACS ❑ DIVCHED

$2YC_3$ Members ❑ NEW ❑ RENEWAL

Conference FEES

Conference Registration*	$10.00	_____
Friday Lunch**	$6.50	_____
Friday Evening Banquet**	$20.00	_____
Saturday Lunch**	$9.50	_____
	TOTAL***	_____

*Includes a 1989 membership in $2YC_3$. All $2YC_3$ members who have paid 1989 dues and high school teachers do not pay any registraton fee.
****Lunch and Banquet payments must be received by May 11, 1989.**
***Make checks payable to **James R. Peter/Cerritos College/$2YC_3$** and mail along with this form to:

James R. Peter
Chemistry Department
Cerritos College
11110 E. Alondra Blvd.
Norwalk, CA 90650

Please Complete

How will you arrive? ❑ Plane ❑ Automobile

❑ Airport ❑ LAX ❑ Long Beach

Airport Arrival Date _____ Time: _____

Motel _____

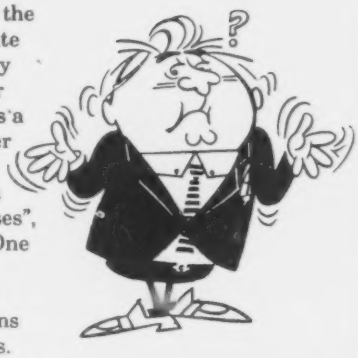
Will you use the college van shuttle? ❑ Yes ❑ No

Departure Date _____ Time _____

Can You Translate Science Into English?

As the public interest regarding chemical spills, recombinant DNA, toxic waste, nutrition and disease, the greenhouse effect, and similar topics , more people will look to the local chemist for an explanation. How do you communicate important scientific concepts to non-scientists? Chemistry often has a bad public image. How do we achieve a better public image of chemistry in and out of the classroom? As a chemist, how much can you explain about these and other currently relevant topics?

At our 105th conference in Norwalk, CA, in May, you can hear presentations on "Nutrition and Chronic Diseases", "Chemistry for Citizens", "Science and Human Values...One Culture", and "Application of Recombinant DNA". This conference could help you communicate these topics and related issues to the non-scientific community. Make plans to attend the conference, and learn and share with others.



TMCC Truckee Meadows Community College
7000 Dandini Boulevard
Reno, Nevada 89512-3999

John V. Clevenger, Chairman
COMMITTEE ON CHEMISTRY
IN THE TWO-YEAR COLLEGES
Division of Chemical Education
American Chemical Society

Nonprofit Org.
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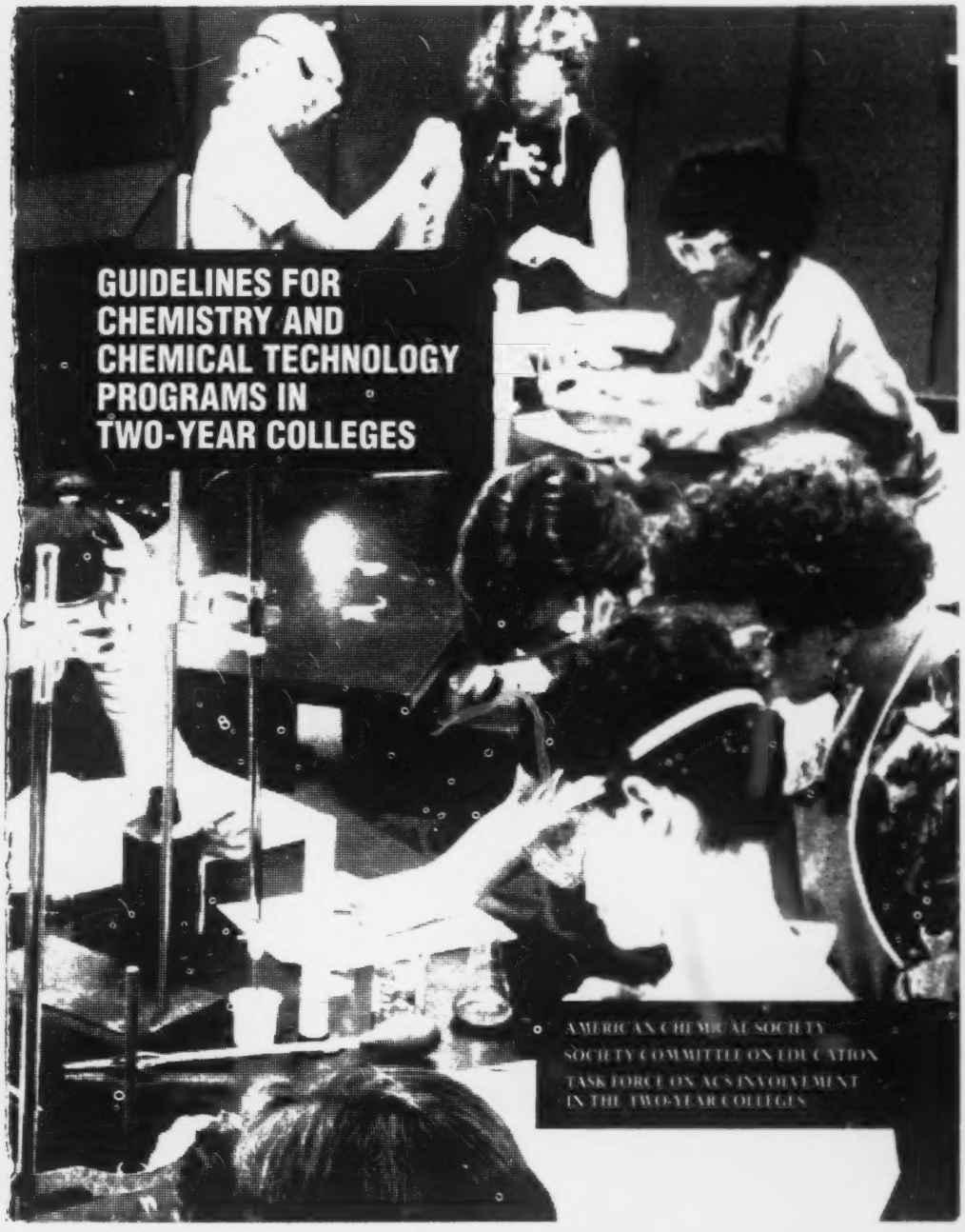
GUIDELINES FOR
CHEMISTRY AND
CHEMICAL TECHNOLOGY
PROGRAMS IN
TWO-YEAR COLLEGES
AMERICAN CHEMICAL SOCIETY
SOCIETY COMMITTEE ON EDUCATION
TASK FORCE ON ACS INVOLVEMENT
IN THE TWO-YEAR COLLEGES

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American Chemical Society
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TABLE OF CONTENTS

Introduction 1
Scope and Aims of Guidelines 1
Types of Institutions 1
Use of Guidelines 1
Areas of Concern 1
Chemical Technology Programs 2

I. CHEMISTRY PROGRAM MISSION AND REVIEW (S1-S2) 2

II. ORGANIZATIONAL STRUCTURE FOR CHEMISTRY PROGRAMS (S3) 3

III. FINANCIAL SUPPORT (S4-S5) 3

IV. THE CURRICULUM (S6-S47) 4
A. Program Development (S6-S10) 4
B. Course Scheduling (S11-S13) 5
C. Course Prerequisites (S14-S17) 5
D. The Spectrum of Introductory Chemistry Courses (S18) 6
E. General Chemistry for Science and Engineering Majors (S19-S20) 7
F. Preparatory Chemistry Courses (S21) 7
G. Chemistry Transfer Programs (S22-S28) 7
H. Chemical Technology Programs (S29-S39) 9
I. Chemistry Courses for Other Programs (S40-S47) 11
1. Nonscience/nontechnology students (S41-S42) 11
2. Allied health professions/occupations (S43-S45) 12
3. Engineering technology and related occupations (S46) 12
4. Other occupations and special-interest groups (S47) 13

V. FACULTY AND SUPPORTING STAFF (S48-S59) 13

VI. STUDENTS AND COUNSELING (S60-S66) 15

VII. ARTICULATION WITH SECONDARY SCHOOLS, TRANSFER INSTITUTIONS, AND INDUSTRY (S67-S72) 16

VIII. FACILITIES (S73-S90) 17
A. Lecture Rooms and Office Space (S73-S77) 17
B. Student Instructional Laboratories (S78-S85) 17
C. Instructional Support Facilities (S86) 18
D. Library (S87-S90) 18

Each of the standards in this document is labeled with an "S" followed by a number. This notation enables users of the document to easily locate specific references to areas of interest.

INTRODUCTION

The *Guidelines for Chemistry and Chemical Technology Programs in the Two-Year Colleges*, developed by the American Chemical Society (ACS), provide a comprehensive model for two-year colleges that grant associate degrees and for non-baccalaureate chemical technology programs offered at other institutions. These *Guidelines* allow institutions to review the quality of their chemistry and/or chemical technology programs[1] (see page 20 for footnotes) and related services by serving as

- a guide for institutional self-studies and program reviews,[2]
- a set of standards for program review and evaluation through the College Chemistry Consultants Service,[3] and
- a resource for regional accrediting groups when revising self-study guidelines and conducting visitations for periodic assessment of programs.[4]

Scope and Aims of Guidelines

The *Guidelines* are meant to help faculties provide chemistry students with the best possible education in the fundamental areas of modern chemistry and its relation to other disciplines and to society. To achieve this goal, general curricular goals rather than specific curricular content are defined. Implementing the *Guidelines* can ensure that the chemistry course offerings and programs of an institution

- are consistent with the mission of the institution,
- meet the needs of the diverse backgrounds and abilities of entering students,
- utilize and enhance the strengths of the institution and the community,
- articulate with the chemistry programs at those four-year colleges to which most students transfer (referred to throughout this document as the major transfer institutions),
- are comparable to programs of recognized quality,
- meet local industries' needs for technical personnel, and
- augment the continuing education and other local community chemistry education needs.

Types of Institutions

The *Guidelines* are designed to accommodate all those postsecondary institutions generally referred to as two-year, associate-degree-granting colleges. They attempt to take into account the great diversity of these institutions and their programs, the great heterogeneity of the student body, the diverse curriculum, and other characteristics unique to these institutions. The *Guidelines* describe optimum standards for a comprehensive two-year college chemistry program and for a modern laboratory-oriented chemical technology program. Institutions that do not have a comprehensive mission may find that some of these standards are not applicable to their mission. In such cases, the standards applicable to their mission should be used in the review process. Institutions that have low enrollments may find it difficult to achieve some of these standards. In such cases, the *Guidelines* may help give a direction to future program development and growth.

Use of Guidelines

These *Guidelines* are intended to improve programs rather than to approve or disapprove them.[5] Institutions should carefully consider their rationale for deviation from a standard and provide explanation in a self-study document. External consultants can evaluate these self-study reports to determine if the *Guidelines* are being followed as closely as feasible. Often the consultants can help colleges develop creative solutions to problem areas as well as devise approaches that provide greater compliance with the *Guidelines*.

Areas of Concern

The *Guidelines* are concerned with chemistry transfer courses and programs for science and engineering majors, chemical technology courses and programs, and

other chemistry courses not included above, such as those for allied health occupations and nonscience majors. (Section IV reflects this organization.) The *Guidelines* are also concerned with the quality of the chemistry faculty and its supporting staff, student and counseling services, articulation with other institutions and local industries, and facilities.

Institutions adhering to these *Guidelines*, especially the appropriate articulation standards, should find that science and engineering majors can transfer to most four-year institutions without difficulty; that students completing chemical technology programs can find employment more easily; and that the quality of the chemistry education of all students has been improved.

Sections that follow describe a comprehensive model. The self-study forms that are to be used with these *Guidelines* relate to each of the standards. The standards are to be considered as characteristics of the model; they are marked with a boxed S type of notation and the text is printed in bold type.

Chemical Technology Programs

Chemical technology programs may be organized in a number of ways within the institutional structure. They may be a part of an independent unit usually referred to as a chemistry department or may be part of a larger unit including other technologies and sciences. In rare instances, they may exist outside the aforementioned structures as an independent program. Whatever the institutional placement of chemical technology programs, there are minimal standards to be met, and they are dealt with in the appropriate topical sections of these *Guidelines*. Those institutions that are concerned only with chemical technology programs and not with chemistry courses for other students will find the chemical technology curriculum standards, (S29) through (S39), of particular interest. Additionally, many of the standards in sections III (Financial Support), V (Faculty and Supporting Staff), VI (Students and Counseling), VII (Articulation), and VIII (Facilities) are applicable to chemical technology programs.

I. CHEMISTRY PROGRAM MISSION AND REVIEW

S1 **Chemistry education in the two-year college has a strong institutional commitment to the**

- **preparation of students for careers and upper division work in chemistry, biochemistry, and chemical engineering;**
- **improvement of the chemical literacy of students preparing for other scientific and technical professions and occupations;**
- **increase of the scientific and technological literacy of nonscience students; and**
- **preparation of students for employment as chemical technicians or in chemically related technologies.**

The structure and scope of an institution's program in chemistry are governed by its educational objectives and resources in relation to the needs of all those it serves. The institution must recognize that chemistry is important in many disciplines and technologies and in the intellectual lives of students seeking a liberal education, regardless of their major. The institution's financial commitment to its chemistry program must be sufficient to provide up-to-date instrumentation and supplies and adequate technical and other support services to the faculty. Moreover, institutional policies must allow for efficient, continuous operation of the program.

S2 **The institution has established procedures for periodic evaluation of the effectiveness, level of achievement, and degree of compatibility of its programs with its objectives. When available, discipline-oriented guidelines are used as a part of these program reviews.**

These guidelines, when used for self-study, should seek evidence of the continuing ability of the entire chemistry program to serve its students optimally, recognizing their different needs, interests, and career goals.

II. ORGANIZATIONAL STRUCTURE FOR CHEMISTRY PROGRAMS

S3 **The chemistry programs are administered by the chemistry faculty organized as an independent unit. The faculty has participatory responsibilities in matters such as budget development; chemistry faculty selection, evaluation, promotion; course development; assignment of teaching responsibilities; grading standards; and professional development. The faculty has control of the budget once it is established. At those institutions where chemistry faculty are a part of a larger unit, they have sufficient involvement to function autonomously as set forth above.**

III. FINANCIAL SUPPORT

S4 **The institution has made a financial commitment to the continued operation and stability of a quality chemistry program. Specifically, budgetary allocations provide for**

- **qualified full-time faculty, competitively compensated, of sufficient size and breadth to staff effectively the chemistry courses necessary to serve the educational needs of the students;**
- **qualified part-time faculty, competitively compensated, as needed to provide specific expertise or to accommodate term-to-term fluctuations in enrollments (not to serve as replacements for full-time faculty on anything other than a short-term emergency basis);**
- **trained laboratory technical support staff of sufficient size to provide necessary preparation, demonstration, and stockroom services;**
- **secretarial and clerical help, including student assistants, to aid and lessen the noninstructional work load of the faculty;**
- **media production and assistance as well as library bibliographic assistance necessary to facilitate a high-quality, up-to-date program of instruction;**
- **instructional support services and learning aids compatible with the needs of the instructional program and conveniently accessible to the chemistry faculty and students, such as tutorial services, computer facilities, library resources (including scientific journals and reference materials), audio-visual resources, programmed learning materials, and chemical model sets;**
- **expendable supplies and capital equipment acquisitions required for modern, high-quality laboratory and lecture instruction;**
- **management and disposal of chemical laboratory wastes;[6]**
- **timely equipment maintenance and repair, or replacement;**
- **opportunities for professional growth and development of the faculty, including travel to professional meetings, workshops, seminars, and courses;**
- **sabbatical and professional development leave; and**
- **insurance to cover the faculty for liability while carrying out their professional duties and to replace stolen/damaged equipment and supplies.**

The institution's financial commitment to its chemistry program should be evaluated with respect to these guidelines. In those areas where the budgetary guidelines are not met, institutions should develop long-range plans to improve their financial commitment.

The college board and administration must recognize that laboratory-based science programs, like vocational-technical occupational programs, are more expensive to operate than most other curricula in the two-year colleges.

S5 **If unable to provide financial support as outlined in (S4) from regular funding sources, the institution actively seeks industrial and/or foundation support and strives to convince the governing authorities of the need for differential funding for science laboratory-based programs.**

IV. THE CURRICULUM

A. Program Development

S6 **The curriculum includes the necessary chemistry courses to accommodate varied student and program needs. Each chemistry course is justified in terms of one or more functions of the two-year college, namely, transfer, occupational training, general education, remediation, counseling and guidance, and community service.**

In program development, the institution recognizes that, as a result of open-door admissions policies, there is great diversity in the educational background, learning readiness, academic ability, and educational goals of students.[7] It must accept the fact that all students are not prepared to begin chemistry at the same level, and that all programs requiring chemistry do not cover identical topics. Using these *Guidelines* to evaluate a program, the institution should consider the size of the student body and the diversity of the students' educational backgrounds in order to establish the structure of the chemistry curriculum and the presentation of subject matter. In this curriculum section, chemistry curricular areas are outlined for the following three groups of students: science and engineering majors, chemical technology majors, and other majors. The latter group includes, among others, students in allied health occupations, engineering technologies, and liberal arts. Additionally, the number of underprepared and remedial students makes it necessary for many institutions to include preparatory or developmental chemistry courses to prepare these students for the college-level courses.

Typically, comprehensive two-year colleges include one sequence of chemistry courses for chemistry, biochemistry, and chemical engineering majors. This sequence also satisfies the needs of other science majors (e.g., physics, biology, and geology), other disciplines of engineering, pre-professional health science majors (e.g., pre-medicine, pre-dentistry, pre-veterinary medicine, and pre-pharmacy), and some natural resource majors (e.g., pre-forestry and agriculture). This sequence typically involves two years of chemistry--one year of general chemistry followed by one year of organic chemistry. However, there may be considerable variation in the second-year program. Not all majors are required to complete the full two-year sequence: some leave after the first semester, a larger group leaves at the end of the first year, and others leave after a third semester.

In addition to the above sequence, many comprehensive two-year institutions provide additional introductory courses tailored to the needs of other groups of students, including a two-year occupational program in chemical technology in locations where there is a concentration of employment opportunities for chemical technicians.

S7 **When there is significant variation from the curriculum mode described in these *Guidelines* (due to regional influences of the transfer colleges, demography, philosophy, or a unique curriculum organization), the chemistry program meets the goals of this model but in a different manner.**

The Society encourages diversity as well as quality in chemistry programs. Each institution should define its mission and develop chemistry programs that best achieve its mission. Change and experimentation preserve the vitality of chemistry education and provide timely career options for students. Programs that are experimental in both content and teaching methodology are strongly endorsed. Despite variations, all good programs maximize the amount of chemistry that students learn, help students develop positive attitudes toward science, and help

students recognize the contributions as well as the limitations of science and technology.

S8 **Chemistry courses and extracurricular activities include the relationship between chemistry and the other disciplines and the impact of chemistry on both technology and society.**

The obligation to provide for the educational needs of students in a variety of curricular and extracurricular areas is a challenge to the chemistry education profession. The profession can make a significant contribution both to the careers and to the intellectual development of all students and to their ability to function as citizens and community leaders in an increasingly scientific and technological society. Extracurricular activities that can contribute to an understanding of careers in chemistry and related disciplines as well as the interrelationships mentioned in this standard include ACS Student Affiliate Chapters, student science clubs, seminar and lecture series, and field trips.

S9 **Chemistry department personnel and all administrators are firmly committed to safe practices in the use and disposal of chemicals. The safety of students and faculty, as well as the protection of the environment, must be of the highest priority when curriculum and budget decisions are made. This includes**

- **instruction in safety concepts, attitudes, and practices in courses,**
- **proper instruction and implementation of safe practices in all laboratories, as well as in all lecture and laboratory demonstrations, and**
- **use of safety equipment and practices in accordance with all federal, state, and local regulations regarding the safe handling and disposal of chemicals and chemical wastes.**

A member of the chemistry faculty is designated to coordinate all aspects of the chemical safety program in cooperation with appropriate institutional and other departmental safety programs.

Specific references to safety in the chemistry program may be found in appropriate sections of these *Guidelines* along with references to safety procedures and standards.

S10 **Through local advisory committees, the college assesses the need for program changes to account for advances. In response to demonstrated needs, programs may be added, altered, or discontinued.**

This may include adding new occupational programs in which chemistry, biochemistry, chemical engineering, and/or chemical technology are combined with other disciplines and technologies, e.g., biotechnology technician, polymer technician, and scientific laboratory technician programs.

B. Course Scheduling

S11 **A schedule of chemistry courses satisfying these *Guidelines* is published annually and widely distributed, permitting students to schedule courses in proper sequence. The schedule provides reasonable flexibility for a student's orderly and normal progress into the transfer institution or the chosen occupational career.**

In this regard, the Conference on Critical Issues in Two-Year College Chemistry[8] stressed the need for colleges to offer all courses for science and engineering students at least once each academic year.

S12 **The college is flexible in scheduling its chemical technology courses. These courses are organized and scheduled to meet the needs of all its students, whether they are enrolled full-time, part-time, or for continuing education.**

S13 **The schedule of chemistry courses that service the various occupational programs is coordinated with the schedule of the other required courses for these programs.**

C. Course Prerequisites

S14 **The prerequisites for each chemistry course have been carefully considered by the faculty and are continuously validated by student success in the course. The**

prerequisites must be clearly stated and publicized in the college catalogues, in the schedule of classes, and in all published curriculum brochures and program sheets.

Wide dissemination of the prerequisites for enrolling in each chemistry course will minimize registration problems, promote student planning, and ensure good public relations.

S15 **All those involved in admitting students to chemistry classes (administrators, counselors, faculty, etc.), understand the need for the stated prerequisites and adhere to them when approving student enrollment in chemistry courses.**

Adherence to the established prerequisites for chemistry courses is necessary for the maintenance of quality programs. The Conference on Critical Issues in Two-Year College Chemistry strongly recommended that colleges adhere to stated prerequisites for enrollment in a course. Failure to do so leads to increased student failure, increased drop rates, and a lowering of the quality of instruction. Additionally, qualified students with the necessary prerequisites may be deprived of enrolling in a class that becomes closed due to inadequate enforcement of the prerequisites.

S16 **Students deficient in the prerequisites for a given chemistry course are required to complete appropriate preparatory course(s) (in chemistry, mathematics, and/or developmental skills) designed to improve their success in the desired course or program.**

S17 **An effective assessment is made of each student's preparation and readiness for the course by testing, transcript evaluation, and counseling.**

D. The Spectrum of Introductory Chemistry Courses

S18 **Considering the college goals, the various programs, the characteristics of the student body, and the enrollment in the chemistry program and in the college, an optimum spectrum of introductory chemistry courses can be offered.**

Generally, introductory chemistry courses are completed during a full-time student's first year. It provides the first introduction to the study of chemistry for students who did not study it in high school. Among other topics, introductory courses deal with matter--its properties, structure, composition, and changes in composition, as well as changes in energy accompanying chemical and physical changes. These courses are general in nature and typically include material from one or more of the several subdisciplines of chemistry (e.g., inorganic, organic, analytical, physical, and biochemistry). The knowledge and skills of chemistry needed by students in certain occupationally oriented programs is so specialized, and the time allowed for acquiring it is so limited, that introductory courses for these programs include highly selective topics. Introductory chemistry courses, differentiated either by the student's major or level of preparation, include

- chemistry for the science and engineering professions,
- chemistry for chemistry-based technology occupations,
- chemistry for the nonscience and/or nontechnology students,
- chemistry for allied health and other biology-related occupations,
- chemistry for engineering technologies and related occupations,
- chemistry for underprepared students, and
- chemistry for other occupational or special-interest groups

Due to differing needs, interests, and backgrounds of student groups for whom they are intended, the aforementioned courses may vary in content, orientation, and level of chemical and mathematical sophistication. Some of these courses stress laboratory work and related knowledge and skills (especially mathematics) more than introductory courses in the other sciences. For either pragmatic or philosophical reasons, a given introductory course may serve the needs of two or more of the student groups listed above (e.g., both preparatory and general education students, or both allied health occupational and general education students.) However, with such combinations, care must be taken to ensure that the needs of any group are not compromised.

The general chemistry course is the foundation course of the program. Once designed, it greatly influences the characteristics of the second-year and preparatory courses as well as the other introductory chemistry course offerings. The general chemistry and preparatory courses are discussed briefly in the next two sections, prior to considering the chemistry transfer program, whereas introductory chemistry courses devoted to chemical technology programs and other majors are discussed in later sections.[9]

E. General Chemistry for Science and Engineering Majors

S19 **The minimum prerequisites for the first term of the general chemistry course for science and engineering majors sequence are the equivalent of one year of high school chemistry and three years of high school mathematics, including two years of algebra. For students deficient in these prerequisites, the college offers and requires the successful completion of a preparatory chemistry course as well as the necessary mathematics courses.**

S20 **Although the general chemistry course sequence is organized around traditional chemistry topics, it includes related major developments in such disciplines as biology, geology, physics, mathematics, and engineering.**

F. Preparatory Chemistry Courses

S21 **The curriculum includes a preparatory course for students who intend to continue into the general chemistry course and who have not previously studied chemistry or have inadequate preparation in the subject. It is designed to improve their chemistry knowledge and skills before they enroll in one of the other introductory chemistry courses. The preparatory course includes a limited introduction to the basic terminology and principles of chemistry including, among others, modern concepts of atomic structure, bonding, oxidation numbers, formulas, equations, stoichiometry, and chemical reactions. It emphasizes chemical calculations and includes one laboratory session per week.**

A preparatory course is helpful and, in many colleges, essential to maintaining high standards in the general chemistry course. When combined with an effective student assessment and chemistry placement program, the preparatory course helps ensure that students entering the general chemistry sequence are well prepared. The caution in (S18) regarding combining functions into a single course is particularly significant with respect to the preparatory course.

G. Chemistry Transfer Programs

S22 **Science, mathematics, and engineering courses offered for chemistry and other science and engineering majors are carefully articulated with the institutions to which most students transfer.**

Normally, transfer programs for chemistry, biochemistry, chemical engineering, biology, and health professionals include one year of general chemistry followed by one year of organic chemistry. However, some two-year colleges offer analytical chemistry or biochemistry in the second year instead of the full year of organic to satisfy the requirements of the local transfer institutions. Certain transfer students do not require the full two-year sequence; consequently, enrollment may be considerably smaller in the second-year courses than in the first-year sequence.

Ongoing articulation programs with several transfer institutions are necessary. This is particularly true where chemistry programs at senior institutions in a given geographical region are not uniform and when four-year institutions change their chemistry curriculum. Transfer institutions that are unfamiliar with the two-year college program may not consider the two-year college experience to be equivalent to that of the first two years of their institution and may not accept certain courses for transfers. A good articulation program is apt to prevent such problems.

Students wishing to acquire American Chemical Society certification as a chemistry major at the completion of the bachelor's degree should be aware of the approved program as outlined in the publication, *Undergraduate Professional Education in Chemistry: Guidelines and Evaluation Procedures.*[10,11] At the time of

preparation of these *Guidelines*, the Committee on Professional Training (CPT) was developing a similar set of guidelines for a major in biochemistry. Chemical engineering programs are approved by the Accreditation Board for Engineering and Technology, which includes representatives of the American Institute of Chemical Engineers.

For a two-year college chemistry transfer program to match the first two years of an ACS-certified transfer program in chemistry, it must offer structured courses consisting of a minimum of 180 hours of lecture classroom work and a minimum of 240 hours of laboratory work. These hours normally are spread over a minimum of four semesters or six quarters, starting with the first term of a general chemistry (for science majors) course. Each course is four or five credit-hours and includes a minimum of three lecture hours and three or four laboratory hours per week. Many two-year colleges exceed these minimums because their transfer institutions do so and/or because they have found it necessary or desirable to do so.

Some general chemistry courses in four-year institutions contain sufficient analytical or inorganic chemistry to satisfy some of the CPT certification requirements in these areas. Two-year colleges that offer equivalent courses, through careful articulation with their transfer institutions, should find that their students receive similar consideration by the transfer institution.

In addition to the chemistry and mathematics prerequisites described earlier, CPT recommends high school physics as a prerequisite and concurrent enrollment in calculus for admission into the general chemistry course. The physics and calculus recommendation, while desirable, may not be feasible for certain two-year colleges because transfer institutions do not require them. However, the CPT requirement that the general chemistry (for chemistry and other science majors) sequence be a prerequisite for the second-year organic course is valid at two-year colleges.

S23 **Chemistry courses for science and engineering majors incorporate a historical perspective as well as references to current developments in chemistry. Attention is given to chemical safety, the systematic use of the chemical literature, and computer applications in chemistry.**

Emphasis on pure theory can neglect the aesthetic, ethical, humanistic, and practical aspects of chemistry. Consideration of current developments in chemistry include biochemistry, polymer chemistry, and applied chemistry, among other topics.

S24 **Lecture experiments and demonstrations are used when appropriate in the science and engineering major chemistry courses in presenting descriptive material and in generating lasting interest in chemical phenomena.[12] Up-to-date learning aids and media resources, such as computer-aided instruction, audio-visual presentations, and programmed instructional materials, are used to enhance students' interest and learning.**

S25 **Laboratory work in chemistry courses for science and engineering majors is designed to give students hands-on experience in working with chemical phenomena and instrumentation. It is also designed to develop the competence and self-confidence required to**

- **gain a fuller, more practical understanding of and appreciation for chemical concepts,**
- **plan and execute experiments through the use of the chemical literature,**
- **anticipate, recognize, and respond properly to potential hazards in chemical procedures,**
- **keep neat, complete experimental records,**
- **synthesize and characterize inorganic and organic compounds,**
- **perform accurate quantitative measurements,**
- **analyze data statistically, assess the reliability of experimental results, and discuss the sources of systematic and random error in experiments,**
- **interpret experimental results and draw reasonable conclusions, and**
- **communicate effectively through oral and written reports.**

8

S26 **Laboratory work gives students hands-on experience and an opportunity to acquire competence and self-confidence in the use and understanding of modern laboratory instruments at a level equivalent to that of students in the major transfer institutions.**

Typically, most laboratories should be equipped with
- analytical balances,
- pH meters,
- recording spectrophotometers (infrared, ultraviolet, and visible), and
- gas chromatographs,

and further, may include
- nuclear magnetic resonance spectrometers,
- liquid chromatographs,
- atomic absorption spectrophotometers and flame emission photometers,
- automatic temperature control devices, and
- computerized data acquisition stations.

S27 **The second-year program, especially organic chemistry, includes training and experience in the use of information from the enormous and rapidly expanding chemical literature equivalent to that in the major transfer institutions.**

Because of the increasing volume and complexity of chemical literature, students are no longer able to acquire skills in information retrieval without some formal instruction. These skills (e.g., using *Chemical Abstracts* and other compilations) may be taught through coordinated instruction, by integrating them into courses, and by library exercises and/or research papers as well as on-line interactive computer file experiences. Cooperative library arrangements with nearby four-year institutions can facilitate this [see (S90)].

S28 **The department provides self-instructional techniques, such as audio, video, and computer courses, as alternative modes to supplement traditional classroom instruction as well as for single-topic short courses.**

Self-instruction programs are available to help students reach a portion of their educational goals without the help of the teacher. Materials are available on such topics as catalysis, chemical engineering, industrial chemistry, polymers, surfaces, and the use of chemical literature. Self-instructional courses on special topics might be offered in cooperation with ACS local sections or local industry. They could be especially useful to those employed in the chemical industry who are not enrolled in two-year colleges.[13]

H. Chemical Technology Programs

S29 **The chemical technology program includes specific training that provides students with entry-level skills for employment as chemical technicians. Additionally, there is a continuing education program for currently employed chemical technicians, including both those who are graduates of a chemical technology program and those who have entered the field without such an education.**

Professional chemists often rely on chemical technicians to make measurements, perform analyses, and carry out experiments. Therefore the technician program must provide the student with the knowledge and skills required to function in this capacity.

S30 **The core curriculum for the chemical technology program includes, as a minimum,**
- **basic chemistry (general, fundamentals, principles) including inorganic chemistry,**
- **analytical chemistry (quantitative analysis),**
- **organic chemistry, and**
- **chemical instrumentation.**

The nonchemistry courses in the core program include, at least,
- **an academic-year sequence of college courses in each of the following: mathematics up through algebra/trigonometry, English composition, humanities/social sciences, and physics or biology; and**

- **a course in computers/computing.**

The program for chemical technology majors can be organized in a number of ways reflecting the institution's missions, the available facilities, and the interests and capabilities of the faculty and students. The Society recognizes and encourages approaches that cover the core material in different ways. Some chemical technology programs use a traditional (lecture, recitation, laboratory) approach, whereas others use an integrated lecture-recitation-laboratory format. Regardless of the approach used, laboratory work must enable students to develop proficiency in laboratory techniques in addition to demonstrating basic principles of chemistry.

S31 **A student in an associate degree chemical technician program has the following minimum experience in chemistry:**

- **170-180 contact hours of classroom work. Up to 30 of these hours may consist of supervised tutorials, active participation in seminars, or supervised self-study programs.**
- **450-500 contact hours of laboratory work, principally as part of a structured course. However, up to 100 hours may be from cooperative industrial experience. If more than 100 hours of cooperative experience is to be substituted, students must prepare detailed project reports for evaluation by the faculty.**

S32 **Not less than one-half nor more than two-thirds of the two-year chemical technology program should be devoted to the core curriculum in chemistry, which is spread approximately equally over the areas of chemistry (including inorganic, analytical, and organic) and chemical instrumentation.**

S33 **Wherever appropriate, attention should be given to examples of biochemistry, polymer chemistry, applied chemistry, chemical safety, and the systematic use of the chemical literature. Computers and computer applications are integrated into lecture and/or laboratory portions of the core curriculum.**

S34 **Laboratory experience in the chemical technology core curriculum reflects the career orientation of the program in that it helps students develop a wide range of laboratory skills, gives them hands-on knowledge of chemistry using state-of-the-art instrumentation and equipment, and fosters competence and self-confidence, enabling them to**

- **use chemical literature to plan and execute experiments,**
- **anticipate, recognize, and respond properly to hazards encountered in chemical manipulations, including being aware of hazardous substances and how to handle and dispose of them and abiding by all safety regulations pertaining to the laboratory area,**
- **keep neat, complete well-organized experimental records,**
- **synthesize and characterize inorganic and organic compounds,**
- **perform accurate quantitative measurements and related calculations,**
- **understand and use up-to-date instruments, particularly NMR, IR, FTIR, ultraviolet-visible, and AA spectrometers, gas and high-pressure liquid chromatographs, electrochemical instruments, laboratory computers including computerized data stations, analytical balances, and pH meters, as well as minor instrument trouble shooting and repair, and**
- **communicate effectively through oral and written reports.**

S35 **The laboratory experiments in the chemical technology program are realistic, stressing practical applications of standard techniques used in modern technology.**

S36 **Students completing the chemical technology program are able to retrieve specific information from the chemical literature and demonstrate that they understand the organization and use of both printed information sources and computer data bases.**

Because of the increasing volume and complexity of chemical literature, students are no longer able to acquire skills in information retrieval without some formal instruction. These skills may be taught through coordinated instruction, by

integrating them into courses, and by library exercises and on-line interactive computer file experiences. Students need to understand the organization and use of the printed information sources in order to use the computer data bases to best advantage.

S37 **The institution is encouraged to participate, where possible, with local industries in a cooperative education program,[14] and to provide an opportunity for students to work in industrial positions prior to completing a chemical technology program. Such academic-industrial interface programs are designed to provide students with**
- **an appreciation of technology,**
- **exposure to team research, interdisciplinary research, societal problems, and points of view complementary to those of academia,**
- **exposure to both pure and applied chemistry,**
- **an opportunity to use sophisticated instruments in a practical setting,**
- **early professional experience, contacts, and information for career planning, and**
- **practice in preparing and delivering oral and written reports .**

S38 **The institution cooperates with local chemical industries in a variety of ways, including the establishment of a chemical technology program advisory committee. The advisory committee advises the college on the needs of the local region for chemical technology education and the faculty on the chemistry course content for chemical technology students with respect to the latest equipment and laboratory techniques and methods. The committee also should assist in planning field trips, providing persons for a speakers bureau, facilitating the exchange of faculty and industrial chemists, arranging job interviews for future graduates of the program, and developing strategies for recruiting students.**

S39 **All core courses in the chemical technology program are scheduled and offered on a regular basis, ensuring that students can take them in proper sequence.[15]**

I. Chemistry Courses for Other Programs

S40 **Considering the number of students involved and the demands of the occupational curricula and faculty, the college provides as many separate courses as possible for each of the following student groups:**
- **nonscience/nontechnology students (e.g., the arts, liberal arts, business, etc.)**
- **students majoring in one of the health professions/occupations**
- **students majoring in engineering technology and related occupations**
- **students majoring in other occupations and special-interest groups (e.g., fire science, police science, auto mechanics, etc.)**

Institutional policies and pragmatic considerations, which vary widely, make an impact on these courses. Some colleges may combine two or more groups in the same course. This, however, should not compromise the needs of students in any group. In other cases, the program is so completely determined, with respect to the amount of time devoted to chemistry, the topical coverage required, and the scheduling of classes, that combining groups is precluded.

1. Nonscience/nontechnology students

S41 **If a chemistry course for nonscience students is offered, it is transferable and satisfies the general education science requirement for graduation of both the local and transfer institution. The mathematical requirement is minimal; usually elementary algebra is the only prerequisite. The goal of the course is to acquaint students with the fundamentals of chemistry and its relationship to science, technology, and society. It emphasizes what chemistry is about rather than facts, laws, and theories.**

Topics covered in these courses, which are usually interdisciplinary in nature, may range from environmental chemistry to the history of chemistry. Typically, such courses carry four or five semester credit-hours, consisting of three or four hours of lecture and appropriate laboratory sessions per week as described in (S42).

S42 **The general education chemistry course includes a laboratory consisting of at least one two- or three-hour laboratory session per week. The laboratory work gives the students a brief but first-hand introduction to the properties of chemicals and to what chemists do. It uses the methods of science to relate chemistry to the students' everyday lives. By giving students hands-on experience, the laboratory work will help them develop the ability to**

- **follow directions and use laboratory apparatus to perform quantitative measurements,**
- **interpret experimental results,**
- **draw reasonable conclusions from observations,**
- **communicate effectively through oral and/or written reports, and**
- **learn laboratory safety by practicing proper safety procedures and learning how to deal with hazards inherent in experiments.**

The *Tomorrow* report[16] emphasizes that, whether they are taught to nonscientists, science majors, or chemistry majors, foundation courses in chemistry at the college level must include a substantial component of significant laboratory work.

2. Allied health professions/occupations

S43 **For allied health transfer students (e.g., nursing, physical therapy, home economics, etc.) and other biology-related majors (e.g., agriculture, natural resources, etc.) that do not require general chemistry, the institution offers a course sequence comparable to that required at the institutions to which most of their students transfer.**

Increasingly, this is a one-year sequence that includes carefully selected topics from general and inorganic chemistry followed by topics in organic chemistry and biochemistry. Applications to living systems are emphasized. Generally, the first term requires algebra, and the prerequisite for the second term is satisfactory completion of the first term. Typically, both terms have four semester credit-hours, with three to four hours of lecture and two to three hours of laboratory per week, for a total of eight semester credit-hours. When no organic chemistry is included in the first semester, the preparatory course or the first semester of the science majors sequence may serve as the prerequisite for the second semester. If organic chemistry is included in the first semester, this is generally not feasible.

S44 **Laboratory work includes everything mentioned for the nonscience majors course in (S41) as well as the following:**

- **keeping neat, complete experimental records;**
- **synthesizing and characterizing compounds;**
- **learning special techniques that are used in the health professions (e.g., pipetting, titrating, and colorimetric determinations);**
- **using such instruments as pH meters and visible wavelength spectrophotometers, gas chromatographs, and laboratory computers.**

S45 **If the institution has two-year programs in the health professions, there is a minimum of a one-term chemistry course to service these programs. The content of this course is developed in cooperation with the faculty and advisory committees for these occupational programs. Prerequisites for this course must be consistent with those of the programs serviced.**

Generally, these courses are four or five semester credit-hours and include a two- or three-hour laboratory per week. They are less demanding both in prerequisites and the chemistry covered than the course for the baccalaureate program. They include topics in general chemistry, inorganic chemistry, organic chemistry, and biochemistry, stressing applications to living systems. Laboratory work is similar to that for the nonscience major course (S42) and may include certain laboratory techniques of the two-semester sequence for allied health programs (S44) but few of the instrumental techniques.

3. Engineering technology and related occupations

S46 **For institutions with engineering technology programs that require a background in**

chemistry, there is an appropriate chemistry course offered. The content of this course is developed in cooperation with the faculty and advisory committees for these programs, with prerequisites consistent with those of the programs serviced.

Courses for engineering technology students are generally concerned with selected topics in chemistry and their applications to material science and engineering-related activities. Some colleges provide either a one-term or one-year course that concentrates on such topics as metals, semiconductors, corrosion, polymers, electrochemistry, and so on.

Laboratory work in these courses includes techniques, instruments, and related calculations specific to the applications of chemistry in the technologies. Students are expected to perform accurate measurements, keep neat experimental records, and communicate effectively through oral and written reports. The course requires that students become familiar enough with the library to retrieve information, especially that which relates to their specific technology.

4. Other occupations and special-interest groups

S47 **In institutions where occupational programs other than those discussed above (e.g., police science, fire science, auto mechanics) or where other departments, local industries, or community special-interest groups have indicated a need for a special chemistry course or program, the college has responded by satisfying the need. Such courses are assigned to the chemistry faculty who develop them in cooperation with the occupational faculty or representatives of the industries or special-interest groups concerned. These courses are either a part of the regular chemistry curriculum or included as the chemistry component in the continuing education, community services, or contract education program of the college.**

V. FACULTY AND SUPPORTING STAFF

S48 **The minimum academic preparation required of a chemistry faculty member is a master's degree in a discipline of chemistry (including biochemistry and chemical engineering). In addition, faculty in a chemical technology program are required to have industrial experience and to be familiar with applications of chemical technology. In the selection of chemistry and chemical technology faculty, emphasis is placed on both a competence in chemistry and an ability to communicate an understanding of chemistry to others.**

Further academic training and research is highly desirable, particularly if it stresses depth as well as breadth of knowledge in chemistry. Refer to section on "Use of Guidelines" in the Introduction for an explanation of how to deal with existing deviations from this and other standards.

S49 **There is evidence that all chemistry faculty members keep abreast of current developments in chemistry, chemistry education, and the applications of chemical technology in our society.**

S50 **The institution has an active program to assure equal opportunity in professional and technical employment for women, minorities, and the handicapped. If equal opportunities do not appear to exist, the institution is actively planning to correct the situation.**

S51 **Full-time faculty size is adequate to teach the full range of chemistry courses on a regular basis to meet the needs of students as outlined in the curriculum section of these *Guidelines*.**

Faculty size is determined by the number of different courses offered, the number of sections taught, and the number of students enrolled in the courses. Optimum programs require at least two full-time faculty members or the equivalent in qualified, full-time personnel. Full-time faculty are sometimes given other duties

along with their teaching assignments, and teaching load credit is granted for these duties. Consequently, they are not full-time chemistry faculty members. In such situations, the equivalent of two full-time faculty requires a total of two full-time teaching loads distributed among full-time faculty who possess a minimum of a master's degree in chemistry.

S52 **The number of credit hours taught by part-time faculty does not exceed 25% of the total chemistry offerings.**

Part-time faculty are defined as part-time employees of the college.

S53 **Full-time faculty from other disciplines are not assigned to teach chemistry courses unless they meet the minimum requirement of a master's degree or its equivalent in chemistry, and, for chemical technology programs, also have some industrial experience.**

S54 **Policies regarding salaries, teaching loads, overloads, promotions, tenure and/or continuing contracts, leave policies (sabbatical or other), and hiring practices are sound enough to maintain good faculty morale and to attract and retain chemistry faculty of quality.**

S55 **Teaching loads are such that, after fulfilling all classroom and laboratory teaching responsibilities, meeting required office hours, and satisfying committee assignments, faculty have adequate time and energy for**

- **continuing course and program development,**
- **study to stay abreast of new developments in their educational field,**
- **participation in professional activities, and**
- **instructional research to improve teaching effectiveness.**

S56 **For purposes of faculty load determination, each laboratory contact hour counts the same as a lecture contact hour in the classroom.**

Supervision of a student laboratory, including the preparation for the experimental work and the grading of the laboratory reports, demands time and energy of a faculty member that is equivalent to that required for the preparation and presentation of a lecture. For purposes of establishing teaching-load guidelines, the definition of a contact hour is 50 minutes of time in which a faculty member is required to be present in a classroom or 60 minutes of laboratory teaching or supervising students.

S57 **The normal teaching load in chemistry is 15 contact hours per week or less and/or 450 student contact hours per week or less.**

A student contact hour is given by the number of students multiplied by the number of contact hours. Greater loads can be justified only in terms of factors such as smaller class sizes or fewer numbers of preparations. In such instances, the work load is compared to the standard load, which is based on two courses and students from two or more laboratory sections combined into a lecture section with an average of 30 students per contact hour or less. Teaching loads that exceed this standard risk lowering the quality of the chemistry program.[17] For this reason, teaching loads and contact hours are given considerable weight by consultants when they evaluate a chemistry program and make recommendations for improvement.

S58 **No faculty member is responsible for more than 25 students in a laboratory at one time.**

This standard is based on prudent safety considerations and practice as recommended in the ACS publication, *Safety in Academic Chemistry Laboratories*.[18]

S59 **Secretarial, stockroom, or technical staff is available to relieve faculty members of the routine chores that detract from academic responsibilities.**

Experience has shown that, to relieve faculty of routine laboratory preparation

chores, at least one full-time laboratory technician for every four full-time equivalents of chemistry faculty teaching loads in chemistry is needed. Any less technician assistance in preparing laboratory solutions and setting up equipment produces undesirable compromises in the laboratory program and in the use of lecture experiments and demonstrations. Colleges with fewer than four full-time chemistry faculty can best serve the chemistry program by hiring full-time laboratory technicians for multiple-discipline assignments, using the same 4:1 ratio. Experience has shown that part-time and student help cannot adequately substitute for full-time laboratory technicians; rather, they often increase the burden on the faculty.

VI. STUDENTS AND COUNSELING

S60 **The primary role of the academic advisor, whether a full-time counselor or a faculty advisor, is to assist students in developing educational goals that are consistent with the students' abilities and interests.**

Because of the multiplicity of programs and the differing requirements for chemistry in the various programs, the counseling and guidance function is particularly important in two-year colleges. The situation is complicated further by the extreme variations among the students in terms of the knowledge and skills necessary for success in chemistry.

Furthermore, the Society encourages two-year colleges to provide information to chemistry students regarding transfer programs, allowing them to combine a basic chemistry education with studies in other disciplines. For example, a major in chemistry with supporting work in biology is recognized as a wise program for students planning careers in medicine, dentistry, or pharmacy. In addition, many careers in the chemical industry, government, and other areas are open to graduates who have a good background in chemistry combined with such subjects as computer science, law, economics, environmental science, and library science, as well as history, literature, and philosophy.

Colleges are encouraged to utilize discipline-specific counselors and advisors so as to promote familiarity with chemistry and chemistry-related programs and to facilitate articulation with both the four-year colleges and industry.

S61 **Counselors and advisors are familiar with the career opportunities for students in both occupational programs and transfer programs. They also are familiar with the academic preparation necessary for entry into the various chemistry courses. They encourage students with strong interests and abilities in chemistry to continue their education in chemistry, biochemistry, chemical engineering, or chemical technology.[19]**

S62 **Counselors and advisors advise transfer students in their selection of chemistry and related courses to ensure that they will coordinate and articulate successfully with those of the senior institutions to which they plan to transfer. Students anticipating transfer to a four-year institution are counseled to complete all terms of sequential courses (e.g., the general chemistry sequence and the organic chemistry sequence as well as other science and mathematics sequences) prior to transfer.**

Counselors and advisors have established clear lines of communication with the chemistry and other science departments of the schools to which students normally transfer, as well as with the broader college articulation offices.

S63 **Chemistry faculty and science administrators work closely with counselors to make sure that the information all three groups possess is up to date and accurate.**

S64 **Students in chemical technology programs are encouraged by their counselor or advisor to elect courses in communications, business administration, economics,**

marketing, engineering, electronics, and microbiology as a means of broadening their career options.

Many career opportunities for chemical technicians are in industry or in various independent or government laboratories. Knowledge in the subject areas listed herein is valuable.

S65 **Colleges with chemical technology programs have one or more members of the chemical technology faculty responsible, with appropriate teaching load credit, for**
- **monitoring the employment needs of industry,**
- **assisting in the planning of or actively engaging in the recruiting of students,**
- **coordinating the job placement of chemical technology graduates, and**
- **conducting detailed follow-up studies of former students of the chemical technology program.**

S66 **Colleges have faculty participate in activities that serve to develop their understanding of the chemical industry, the relationship between chemistry and the other disciplines, and the mutual impact of chemistry on technology and society. The faculty can then, in turn, encourage their students to participate in such activities.**

These activities include ACS meetings at the national, regional, and local levels; advisory committee meetings; technician affiliate group meetings; student affiliate chapter meetings; and others.

VII. ARTICULATION WITH SECONDARY SCHOOLS, TRANSFER INSTITUTIONS, AND INDUSTRY

The quality and success of chemistry programs in two-year colleges is dependent upon articulation with secondary schools, transfer institutions, and industry in the local area. The reader is also reminded of the several earlier standards (S22, S38) concerned with articulation.

S67 **The college works with appropriate faculty and administration of its "feeder" high schools and with other potential sources of students to keep them aware of the curriculum requirements and career potentials for the graduates of its transfer and occupational chemistry programs.**

S68 **The chemistry faculty, administrators, and counselor/advisors are informed of curriculum revision and changes in transfer requirements at the major transfer institutions. This information is used when necessary to revise the chemistry courses and sequences and the counseling and advising.**

S69 **The college should conduct regular and detailed follow-up studies of its transfer students as well as those in the occupational programs and communicate this information, in a timely manner, to the faculty, administrators, and counselor or advisors. These follow-up studies include both academic and/or employment data and former student opinions.**

S70 **The college has sharing agreements with neighboring four-year and two-year institutions and industries, effectively expanding the chemistry offerings, library, laboratory facilities, and expensive instrumentation available.**

Programs at two-year colleges are strengthened and enriched by the utilization of resources from other nearby agencies. Second-year and specialized occupational courses especially can be extended and enriched in this manner. Likewise, availability of research facilities for use by faculty members and independent study

students may be increased.

If two or more institutions in the same geographical area are unable to offer a complete two-year college chemistry program individually, they might combine resources and facilities to provide a full, strong two-year chemistry program. Furthermore, such an arrangement could provide the specialized chemistry needs for occupational programs and the general education needs in science for the nonscience students.

S71 **The college assists schools in its local area with the enrichment of their chemistry programs.**

S72 **The college sponsors programs that help promote a favorable image of chemistry among the general public.**

VIII. FACILITIES

A. Lecture Rooms and Office Space

S73 **The chemistry classrooms and offices are located near the instructional laboratories and preparation facilities.**

S74 **The chemistry classrooms meet modern standards of lighting, ventilation, and comfort.**

S75 **Classrooms have adequate provision for using all types of audiovisual aids, and the availability of a hood (either permanent or portable) for demonstrating chemical phenomena. Equipment for mounting and displaying charts is available. Easy access for laboratory carts to carry demonstration materials is provided.**

S76 **Faculty offices are readily available to students and located so as to encourage faculty-student contact.**

S77 **Faculty offices and classrooms are accessible to the handicapped.**

B. Student Instructional Laboratories

S78 **Laboratories are well lighted and ventilated, and are equipped with such services as gas, water, and electric power.**

S79 **Neither the laboratory program nor the students' and staff's well-being are compromised by a lack of well-maintained, working fume hoods and hood space.**

S80 **There is a minimum of 28 square feet of laboratory space per student for the introductory courses and 42 square feet per student for second-year courses.**

S81 **The laboratories are fully equipped with well-maintained and properly functioning safety features such as eye wash, safety shower, fire blanket, and fire extinguishers. Safety instructions are posted in the laboratory, and safety goggles must be worn by everyone in the laboratory and preparation areas.**

The college faculty and administration should refer to the publications mentioned in footnotes 6, 18, and 20 for additional information on safety in the academic laboratories and in the ordering, handling, and disposal of chemical waste materials.

S82 **Laboratory facilities comply with the regulations of federal, state, and local agencies.**

S83 **Laboratories are located to provide convenient routes to stockrooms and preparation areas.**

S84 **Laboratory facilities have provisions for the safe instruction of the physically handicapped.[20]**

S85 **For safe supervision of students, laboratories should have no more than 25 stations. Where more stations exist, no more than 25 students are assigned to an individual laboratory instructor. See (S58).**

C. Instructional Support Facilities

S86 **Service areas, such as the rooms for storage and preparation and auxiliary instructional areas for faculty and student special projects, are conveniently located and large enough to provide for the needs of the students and the faculty for instrument, equipment, and computer utilization, as well as storage, preparation, and study.**

Other such areas include balance rooms, instrument rooms, computer rooms, study areas (with access to library resources), and special storage and receiving areas.

D. Library

S87 **The chemistry library collection is within or near the science building. It consists of holdings commensurate with the size and nature of the chemistry offerings and the research activity of the students and staff.**

S88 **The library collection includes a minimum of 10 current chemistry and related science periodicals, plus a range of other reference materials suitable for the course offerings of the department. The collection includes back issues of five years or more for each of these periodicals.**

S89 **For institutions with a central, main library, a departmental or science reading room is strongly recommended. Such a room would have the important reference materials and current periodicals close at hand when needed by staff and students, especially those engaged in advanced courses, research, and independent study.**

S90 **The college has cooperative library arrangements with nearby two- and four-year colleges as well as with local industries.**

Please address comments and questions regarding these *Guidelines* or any other ACS programs, publications, and services to the Office of College Chemistry, American Chemical Society, 1155 Sixteenth Street, N.W., Washington, DC 20036.

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Footnotes

[1]Throughout this document the term "chemistry program(s)" will be used to refer to all parts of chemistry and/or chemical technology programs.

[2]Available from the Office of College Chemistry, American Chemical Society.

[3]Available from the Office of College Chemistry, American Chemical Society.

[4]The Conference on Critical Issues in Two-Year College Chemistry has recommended that the Commission on Postsecondary Accreditation, the American Association of Community and Junior Colleges, and the American Chemical Society cooperate to form a task force to study ways in which the regional accrediting associations and the scientific disciplinary organizations can work together to improve the quality of two-year college science education through the regional accrediting process. Copies of the report of the conference are available from the Office of College Chemistry, American Chemical Society.

[5]The American Chemical Society does not have any approval or accreditation programs for chemistry in the two-year colleges.

[6]See *Less is Better*, available from the Office of Government Relations and Science Policy, American Chemical Society.

[7]Colleges are experiencing, in increasing numbers, students for whom English is not the native language. Colleges are encouraged to develop experimental programs designed to assist these students whose cultural backgrounds do not provide experiences similar to those of the average American student.

[8]See footnote 4.

[9]The ACS will periodically publish supplementary documents to these *Guidelines* , including suggestions for course content and other curriculum-instruction matters.

[10]Available from the Committee on Professional Training, American Chemical Society.

[11]Two-year colleges must provide experience in mathematics, physics, biology, computer science, and other required subjects comparable to those required in the major transfer institutions for majors in chemistry, biochemistry, and chemical engineering.

[12]Refer to (S9) regarding appropriate safety considerations.

[13]Refer to ACS continuing education materials and their availability. Write to Continuing Education, American Chemical Society.

[14]For further information regarding co-op programs, write the Academic-Industrial Education Program, American Chemical Society.

[15]Refer to (S12) for additional comments on scheduling of chemical technology courses.

[16]The 1984 Report of the Task Force for the Study of Chemistry Education in the United States, *Tomorrow*, recommends that the ACS establish guidelines regarding the appropriate balance among the fundamental principles of chemistry, applications of chemistry, and the place and role of the chemical sciences in contemporary society for the college-level chemistry courses for nonscience majors. Colleges are encouraged to report on their experiences in balancing these factors. Copies of the report are available from the Education Division, American Chemical Society.

[17]This standard refers to the normal assigned teaching load. Any teaching assignments over this load should be examined carefully to ensure that the faculty member's total responsibilities to the college do not jeopardize the quality of the program.

[18]Copies may be obtained from the Office of College Chemistry, American Chemical Society.

[19]ACS has material that counselors and advisors might find helpful. Write Career Services Program, American Chemical Society.

[20]Copies of *Teaching Chemistry to Physically Handicapped Students* can be obtained from the Department of Professional Services, Committee on the Handicapped, American Chemical Society.